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A TRAGIC DEATH.

A thrill has gone through the electrical community in America at the news of the tragic death by drowning of Mr. S. Dana Greene and his wife. To all who knew them the sense of personal loss is keen and full of anguish. The art could ill spare our late friend, one who was so deeply interested in its welfare, and who was withal so manly, simple and modest. He left behind him a record of good work done with far more than the average intelligence and conscientiousness, and was a worthy representative of that remarkable group of talented men who during the last fifteen years have been drawn from the navy into the field of electrical invention and application. Since the news came of the loss of Dr. John Hopkinson and his family by falling from a precipitous Alpine slope, we know of no accident that has caused so deep and painful an impression as that swift plunge into the icy waters of the Mohawk. In expressing our own grief, we do but voice that of all who cherished Dana Greene's friendship as that of a man at once accomplished and brilliant, kind hearted and true.

THE CAPACITY OF THE AUTOMOBILE.

Step by step the automobile is making its way in the great cities, and the work is still being done chiefly by electricity. The methods adopted with electrical current appear more flexible than those of other systems, and are certainly making rapid strides in development and improvement. Some interesting data in this regard is given elsewhere in our pages this week.

As to the future of the automobile we note some remarkable figures by the veteran English electrical engineer, Mr. R. E. B. Crompton, presented recently before the Automobile Club of Great Britain. If we assume, he said, that motor omnibuses 16 feet 6 inches long were running in an ordinary street and were driven at an average rate of 10 miles an hour, 100 feet apart, this would allow 9 omnibuses per minute or 540 per hour, with a total carrying capacity of 14,080 passengers per hour in one direction. Now Mr. Crompton asserts that he has it on good authority that the best an electric "tramway" could do is 3000 per hour, and that the best a suburban or metropolitan road can do is not in excess of 10,000 per hour. Mr. Crompton attributes the superior ability of the automobile to what he terms the "overtaking space," which permits practically of two lines of travel in each direction, giving four lines of travel for the automobile as compared with two for the trolley car running on tracks.

There can be no question that the automobile stage will hereafter be considered favorably for many places where the trolley or conduit would have been adopted. We think those stages will be electric. The New York *Times* has just gauged the traffic on Fifth Avenue, New York, and found, for example, at Thirty-fourth Street, 374 vehicles passing between 4:15 and 4:30, both directions, up and down the avenue. This is typical but not excessive. If to it were added frequent stages, it seems impossible that, under automobile conditions, anything but electricity would be allowed. The state of Fifth Avenue with those vehicles operated by steam, naphtha,

gasolene, etc., is better imagined than described. "Inferno" might be a fit descriptive word.

ELECTRICITY AND GAS.

Having long been among those who believe that the interests of gas and electricity are essentially the same, in the sense that between them they include the whole domain of light, heat and power, we are not greatly surprised at the event recorded in our pages last week and referred to more fully this week, namely, the acquisition by the Consolidated Gas Company of the electric lighting interests of New York City. Something of this kind was inevitable, and it is only a repetition of what has occurred in a great many other towns and cities in this country. Moreover, it is said that in such a city as Boston the consumption of gas has fallen off already about 2 per cent., instead of increasing, on account of the competition of electricity, so that a truce or peace was in order. Just how far the consolidation may carry its influence, no one can yet tell, but the situation should certainly be susceptible of general improvement and benefit. The Consolidated Company can now bend its energies to the concentration of gas on the departments of heating and cooking, assigning to electricity the major part of the supply of light and power. At least, in that way lies wisdom and profit.

The central station industry in New York City proper—Manhattan Borough—represents a capitalization of not far short of $100,000,000. All the money thus invested may be said to be profitably employed. But it is amazing how much electric light and power work has escaped central station control. As one approaches New York City by the North or East River in the early winter evening, the entrancing spectacle is presented of scores and scores of huge buildings, many of them over fifteen stories high, every window of which is a-glitter with electric light. Yet in ninety-nine cases out of a hundred, those buildings have their isolated plants, and the owners insist that at present prices for current it is cheaper for them to generate it on the premises than to buy it. Are such undeniable conditions to endure or is the central station to become to electric lighting what the gasometer has been to the older form of illumination? It is questionable whether ten private concerns make their own gas to-day in New York City. It is doubtful whether less than a thousand concerns make their own current for light and power, in the same area.

COMPENSATION FOR LINE DROP IN ALTERNATING CURRENT CONDUCTORS.

The article by Mr. E. J. Berg which appears elsewhere in this issue is an admirable and extremely simple elucidation of the subject of compensation for line drop in alternating current circuits by means of overexcited synchronous motors and rotary converters. Heretofore the subject has been involved in mathematics of a complicated nature; and even those who have been sufficiently skilled in mathematical analysis to follow the symbolic treatment, have been baffled in attempting to extract from its processes concrete ideas of the actions represented. In the article referred to, a specific case of power transmission is assumed, the constants of the system calculated by a simple process, and then easy methods given whereby the answer can be determined to almost every question that may come up in connection with the most interesting system of compensation under treatment. Among other conclusions brought out in the article is the very interesting one that a condition is possible whereby an unvarying voltage may be maintained along the whole length of an alternating current transmission line. As pointed out, this may have some advantages in cases where the power is taken off at a number of points along the line and it is desirable to maintain the same voltage at all points, disregarding the load at the receiving end of the line. Usually, however, in applying the system, the generator voltage is higher than the voltage at the receiving end, and the voltage at any point varies with the load.

THE PROPOSED PACIFIC CABLE.

Captain Squier's paper before the last meeting of the American Institute of Electrical Engineers was interesting in many directions other than electrical, as any subject must be which deals with the means of placing nations in communication, and joining hands across the sea. The great depths and distances to be overcome have hitherto deterred the laying of a Pacific cable. It would seem as if the political and commercial necessities of the time make the enterprise imperative. Two general plans are apparently on foot; one to connect Canada with the British colonies of New Zealand and Australia; the other to connect California with the newly-acquired western islands of the United States. Stereopticon views of a few of these newly-acquired coral islands in midpacific clearly showed that they are of value only as stepping stones in the commercial highway, depots for stores, and breathing places for the proposed Pacific cable. Less favored situations for permanent residence might be difficult to find, but this is an entirely unimportant consideration in utilitarian design. Experience has shown that no lighthouse on stormy headland, or lightship on a tempestuous coast, was ever sufficiently bleak, gloomy, or remotely isolated to deter men from seeking its occupation in return for moderate compensation.

There can be no reasonable doubt, from the data forthcoming, as to the practicability of laying a Pacific cable. The question is, who will lay one first? Another question is, what will be the rate charged for transpacific cablegrams to China by the new route? The tariff suggested in Captain Squier's paper was most inveiglingly alluring, but no guarantees have yet been offered. Incidentally, the paper drew attention to the incomplete agreement upon the speed of signalling over various existing long submarine cables. This a necessary consequence of the many different factors entering into the question of signals and signalling. The only common basis for arriving at an estimate is the $C\,R$ of a cable in farad-ohms. It is certain that cables having the same number of farad-ohms have the same actual or potential signalling speed, if, as usually happens, their insulation is nearly the same. Cables having different farad-ohms will have potential speeds inversely proportional to those quantities as a general rule, but numerous deviations and exceptions appear in practice owing to a variety of different sources.

THREE-WIRE DYNAMOS.

On another page there will be found an explanation by Mr. Edward Bretch of the means for connecting the neutral of a three-wire system into the windings of a direct-current generator, the brushes of which are connected to the positive and negative sides of the system. The means is that patented for several uses by Mr. B. G. Lamme of the Westinghouse Company and commercially applied by that company in many selections. Notable among these is the mixed polyphase transmission and direct-current distribution system of the Hartford Electric Light Company. In this case the neutral of the three-wire system is tapped directly into the secondaries of the step-down transformers feeding the converters. For such a case the secondaries of three-phase transformers must of course be Y-connected and the secondaries of two-phase transformers must be (to coin an equivalent term) X-connected.

Another notable instance where the machines are generators and not converters is that of the Boston Southern Terminal station, the electrical equipment of which was described in these columns in the

issue of March 11, 1899. In this case either two or three phases could be used, but the two-phase arrangement was considered, and justly so, preferable, as it gives more taps into the armature winding—four per pair of poles instead of three—and as it allows the use of standard single-phase transformer cores instead of requiring a special three-phase arrangement, which is not commercially used in this country. Each of these transformers is simply wound with a single winding tapped at the center, with an appropriate number of turns for the voltage generated, taking into consideration the low frequency which, in cases of standard direct-current machines, is lower than that of any standard alternating-current system.

NINETEENTH VERSUS TWENTIETH CENTURIES.

The whole civilized world seems to have recently been confronted with the much disputed question as to whether the nineteenth century terminated with the year 1899. It would seem that similar questions have arisen to vex disputatious souls at each corresponding period in past centuries. The fact is, of course, purely one of chronology, and since chronologists have been in the habit of starting any era with the year 1 instead of with the year 0, we, their successors, must needs commence a new century in a similar manner to keep the record correct. On the other hand, however, the epoch at which the entire community has to change the recording date from the number 1899 to the number 1900, is perhaps of more personal interest and importance than the date at which the chronologist marks the transition from the nineteenth to the twentieth centuries, and recalcitrants upon the latter question may be forgiven for the sake of their attachment to the old date numbers.

To electricians the close of the year 1899 has added significance from the fact that the voltaic cell was publicly made known to scientists in 1799, and consequently that the first century of real electrical progress has already terminated. Although much experimental work had been done with high-tension electricity before the voltaic cell was known, yet the lightning rod was its only practical application, owing to the intractability of the high-pressure energy. Although we now utilize high electrical pressures, and shall probably utilize yet higher, this has only been rendered possible as the outcome of familiarity with low pressures. In order to attain the altitude of kilo-volt land, volt-land had first to be thoroughly known and explored by thousands of workers.

Possibly the most significant and important advance in the grand record of the first practical electrical century, is that the discovery of the voltaic cell was disclosed to but a few isolated philosophers. The majority of educated men, evidently listened apathetically to the announcement, even if it reached their ears. In other words, the germ of all the subsequent electrical progress floated idly upon the sea of human affairs and was only picked up by a leisured few who devoted themselves, out of intellectual interest, to a special branch of philosophy. At the present time electrical applications occupy the daily life and business of a whole army of persons, while electricity is studied and superficially understood by many thousands of the intellectual world. It would seem that while civilization progresses, we can never again have a sharp division between industry and physics. The physicist must know something of the world of human needs, and the industrial workers must know something of physics.

One-third of the century following Volta's discovery had passed before the electric telegraph was made a practical possibility. Half the century had expired before the telegraph passed across the sea. The last quarter-century has been many more times prolific of improvement than any predecessor. The electric light, telephone, motor, street car and transmission of power, all belong to it. The question often suggests itself as to how long the rapid pace development set in applied science during the last thirty years can be maintained. Is it possible to sustain not merely the existing development but also the acceleration in development? The precise answer to this question involves prophecy, and is therefore impossible; but a probable answer is readily forthcoming. Progress in applied sciences depends upon the extent of Nature's undiscovered store as well as upon the amount of intelligence and labor expended upon acquiring it. We believe that the depth of Nature's sea of knowledge is for all practical purposes unfathomable, and that consequently everything depends upon the number of trained intelligent workers. The more numerous these become the more rapid will be our progress in all that makes humanity great. Who shall set a limit to the acquisitions of intelligence from the unknown world?

JOSEPH HENRY.

Elsewhere in this issue we print an abstract of a paper read by Mr. James F. McElroy at the celebration held at Albany last month to commemorate the birth of Joseph Henry one century before, in which are enumerated the several great discoveries which place the name of Henry alongside that of Faraday among the great pioneers in electrical science. It is a remarkable incident in the history of science that a man should have performed the magnificent work that Henry did, and through a singularly modest disposition warded off rather than invited recognition for his labors. Such modesty is rare and is usually considered a credit to the possessor. Had Henry, however, given proper publicity to his discoveries as they were made, electrical science would have been greatly advanced, and the world, therefore, has been a loser by his lack of forwardness. It is probable that the scientific environment of those days was such as to give little encouragement to the original investigator, while original publication in American scientific journals, like at present in the *Proceedings* of the American Association for the Advancement of Science, was the equivalent to consignment to oblivion. The same, however, was even more true in the day of Franklin, but that shrewd practical philosopher never hid his light under a bushel, and when undertaking scientific investigations, arranged for publication of the results of his work in the *Proceedings* of the Royal Society, then the principal scientific organ of the world. As a consequence, the learned circles of the entire world were kept informed of his labors, the result being that they gave a tremendous impetus to electrical investigations.

The discovery of the principles of the winding of electromagnets, the invention of the first operative telegraph, the discovery of the oscillatory nature of static discharges and of the principles of inductance—these are achievements which will forever keep the name of Henry enrolled among the greatest in the history of electrical science. There is to be added the independent discovery of electromagnetic induction, but such acknowledgment should not detract from the credit of Faraday, who was not acquainted with the work of Henry, and who, moreover, gave the world full benefit of his labors as soon as they were completed, while those of Henry remained without fruit through lack of proper publicity. Indeed, it was not until the publication in 1878 by the Smithsonian Institute of his writings that the scientific world at large knew of Henry's magnificent original investigations. Happily the day appears to have passed for the work of a Cavendish, a Henry or a Pacinotti to lie fallow to the detriment of scientific progress. The great gap which formerly separated science from the material world has almost entirely disappeared. Now magazines and newspapers vie with scientific journals in solicitation of savants for the earliest publication of their discoveries and investigations—the former, unfortunately, usually for sensational rather than legitimate purposes.

Drowning of Mr. and Mrs. S. D. Greene.

A most lamentable catastrophe occurred on Monday, Jan. 8, at Schenectady, N. Y., when Mr. and Mrs. S. Dana Greene were drowned while skating. Accounts of the disaster vary a little, but the main facts appear at this writing to be as follows: Mr. and Mrs. Greene went to Yates' boathouse, on the Mohawk River, at 5 o'clock, and started out skating. After a short time in the vicinity of Scotia bridge Mrs. Greene suggested to her husband that they raise their skate sail and glide down to Freeman's bridge, a distance of a mile. Mr. Greene immediately prepared the canvas and the two skated down at a rapid rate, as a gale was blowing at the time. About midway between the two bridges and just above the New York Central & Hudson River Railroad bridge is a large strip of open water, fully one hundred yards square, from which the ice had been removed. This part of the river is covered in places by a thin coat of ice. Mr. and Mrs. Greene failed to realize their danger, or were going too fast to save themselves. Their sudden cries for help were heard by the other skaters in the river and by some icemen who had just stopped work. Mr. Henry Proper rushed to the assistance of Mrs. Greene. She was breathing when brought to the shore, but physicians were unable to save her life. Messrs. E. W. Rice, Jr., third vice-president, and J. R. Lovejoy, manager of the supply department of the General Electric Company, requested Mr. N. D. Proper to search for Mr. Greene's body. He organized a party and placed the members in several boats. The men had been at work but a short time when they found Mr. Greene's body near where Mrs. Greene's body was found.

THE LATE S. DANA GREENE.

Lieutenant S. Dana Greene was thirty-five years old and the son of the late Commander S. Dana Greene, who succeeded to the command of the Monitor after Admiral Worden was disabled in the famous fight with the Merrimac, and was a nephew of Major General Francis Vinton Greene. He is survived by his mother, one brother, Lieutenant George D. B. Greene, formerly adjutant of the Second Regiment New York Volunteers during the Spanish war, and a sister, Mrs. J. S. Conover, all of Schenectady.

Lieutenant S. Dana Greene entered the Naval Academy in 1879, graduating at the head of his class in 1883. During the entire four years at the Academy Lieutenant Greene stood at the head of the class, which originally contained more than one hundred members and which graduated fifty-four. His academic career in fact was one of the most notably brilliant in the history of the Naval Academy. After a short term of service at sea, he became actively connected with the old Sprague motor interests, followed them into the Edison General Electric Company, and then on the consolidation of that with the Thomson-Houston Company, became prominently identified with their successor, the General Electric Company. In this corporation he again came to the front, rising rapidly until at the time of his death he was in full charge of all the sales as general sales manager. His great acquaintance with the technique of the art was reinforced by considerable executive ability, and by a gracious *savoir faire* and gentleness that made him deservedly a universal favorite.

During the Spanish-American war, Mr. Greene, who had taken great interest in the formation of the Naval Reserve, went to the front and was under fire as the executive officer of the auxiliary cruiser Yankee. Since the peace he had been serving on the staff of Governor Roosevelt, of New York State, as naval attaché, with the rank of lieutenant commander. He took a deep interest in naval affairs and presented papers on electrical-naval topics before various bodies connected with the navy. He was also a valuable contributor to the proceedings of the American Institute of Electrical Engineers and to those of the New York Electrical Society. Our own columns have from time to time been graced by communications from his pen. An important work to which he had of late devoted attention and energy is the standardization of electrical apparatus and its testing, etc.

Mrs. Greene was the daughter of the late Rear-Admiral Ralph Chandler, an officer of brilliant attainments and high professional standing, who died Feb. 11, 1889, at Hong Kong, while flag officer of the Asiatic Station. The marriage took place a few years ago after a courtship of more than ordinary romance, and it would have been hard to find a more attached and loving pair. Their home life at Schenectady was simply delightful, and one of the sad features of the terrible affair is that Mr. Greene had but just bought a site for a country home in Saratoga County, near Schenectady. The funeral took place at Schenectady on Thursday at 1 o'clock. Interment was at Bristol, Rhode Island.

Independent Telephone Matters.

As intimated in these pages last week, the negotiations for a consolidation of a number of the independent telephone manufacturers were resumed with the object of effecting some kind of a consolidation or combination under the leadership of the new Telephone, Telegraph & Cable Company of America. With this end in view, the American Independent Telephone Company was formed under the laws of Delaware with a capital of $100,000 and power to increase to $10,000,000, for the purpose of acquiring properties of such a nature. As far as can be gathered, the negotiations are off for the present, one of those who attended the conferences saying: "These small Western companies want us to take care of them and pay a good round cash sum for $90,000,000 in stock of doubtful value. Hardly one of these concerns has a working telephone exchange. All they have got in most cases are their incorporation papers. In a few instances, however, they have some valuable franchises, as in Chicago, and for these we would be willing to pay a reasonable sum considerably under $1,000,000. We have been negotiating for some time with them, and in our recent local consolidation deal we arranged matters with a view toward ultimately controlling every independent telephone property in the United States. The people who have come from the West are so obdurate in their attitude, or rather so extravagant in their professions as to the value of their property, that there now seems small prospect of anything being accomplished."

In the meantime the local Knickerbocker Telephone & Telegraph Company is going ahead with its work and will, it is understood, have two temporary exchanges in operation in New York almost immediately. One of the officials of the company has also furnished us with the following schedule of its proposed rates:

For Manhattan, the Bronx and Brooklyn, unlimited service to any points in the five boroughs forming Greater New York, business houses, $120; residence, $60. For Queens and Richmond, unlimited service in districts in each of these boroughs, the districts to be approximately one mile square, business houses, $48; residences, $36. with toll charges for connection with points outside of the district in which the subscriber is located, the subscribers in Queens and Richmond to have the option of taking the rates in force in Manhattan, the Bronx and Brooklyn, if they so desire.

The Knickerbocker Company, it was stated, is now sending out canvassers to secure subscribers. The company could at once begin service on a limited scale, but it is likely to wait until it can start with enough subscribers to warrant the employment of a working staff and with the exchanges fully equipped. The main central office at Broome and Elm streets is almost ready for service, and the exchange in Twenty-third street, near Fourth avenue, is being equipped. The company has about four miles of cables strung in this city and uses the ducts of the Empire City Subway Company. In Brooklyn the Knickerbocker has its own ducts. The boards have been furnished by the Phoenix Company, of New York, and the paper insulated cable by the National Cable & Conduit Company.

Provision is also being made for long distance work within the State and affiliation with other exchanges. On January 5 the Telephone, Telegraph & Cable Company, of Eastern New York, with a capital of $10,000, filed articles of incorporation with the New York secretary of state. The general route of the company takes in the counties of Suffolk, Nassau, Queens, Kings, Westchester, Putnam, Dutchess, Columbia, Rennselaer, Saratoga, Washington, Warren, Essex, Clinton, Franklin, Schenectady, Albany, Greene, Ulster, Orange, Rockland, Richmond and New York. These cities and villages are to be connected: New York, Owego, Elmira, Dunkirk, Buffalo, Niagara, Rochester, Oswego, Watertown, Ogdensburg, Rouse's Point, Richmond, Syracuse and Utica. The directors are William H. Eckert, Walter W. Perkins, Arthur Phillips, William S. Eckert and Frank B. Hall, of New York City, and George W. Snyder and John D. Stauffer, of Philadelphia.

ENGINEERING SOCIETY LIBRARY, UNIVERSITY OF MICHIGAN

The Manufacture of Electric Automobiles.

THE manufacture of electric vehicles is deeply interesting in its details, both to the user of such equipments and to the electrician. For the opportunity to prepare this article descriptive of the methods of manufacture employed by the Columbia & Electric Vehicle Company, of Hartford, Conn., we are indebted to the courtesy of that company.

The factory is located at Hartford, and even in its present state is a very extensive building. The company has, however, acquired in addition the plant of the New Haven Carriage Company, and also that of the Hartford Cycle Works. Besides this, they are also adding a large new building adjacent to their present plant, and the combination will give them manufacturing facilities comparable with those of our largest electric companies. It may be said that in spite of these new additions the company's representatives have expressed the opinion that even then difficulty will be experienced in coping with their orders, a fact that speaks well for the electric automobile industry. It is needless to state that the present plant is crowded to its utmost capacity.

Although the electric equipment of the automobile is what will interest the reader most, yet it will be well to preface this article with a few words concerning methods of wagon body construction. For this department the company has employed carriage building talent and has throughout adopted carriage makers' methods. The designs are studied with great care both with regard to their strength and general appearance, and in numerous cases this preliminary work has gone to the extent of building a complete full size wooden model of the vehicle for the purpose of studying general effect.

Aside from providing accommodations for the batteries and controller, the carriage builders' ideas have been adhered to as much as possible. This is indeed a wise provision from a commercial point of view. The users of carriages and horses are a conservative class and scrupulously avoid anything that suggests a departure from the appearances to which they are accustomed. They are fond of the varnished wood panels, of leather trimmings and dashes and the curves and ornamentations which carriage builders have been wont to use. These are found in the Columbia Electric Vehicle and are only modified to such extents as the exigencies of equipment arrangement, high speed and long runs demand. The carriage bodies are largely built at the works of the New Haven Carriage Company, although, to fill a recent large order, almost all the carriage builders of the eastern states have been kept busy.

FIG. 1.—SHOWING THE NECESSITY OF A FLEXIBLE RUNNING GEAR.

The running gear of electric vehicles has been a serious problem and has been solved in a number of ingenious ways at this factory. One of the most important practical difficulties that must be provided for is that of the lifting of one of the four wheels higher than the others. This is shown in Fig. 1, perhaps an exaggerated circumstance, but clearly depicting the necessity of flexibility in the frame, to which characteristic must be added lightness and strength. The present practice of the company is to construct these frames of thin steel tubing brazed together with suitable fittings. The frame is, roughly speaking, rectangular, being fastened to the rear axle by means of ball bearings and to the front axle by pivoted lugs; a single cross-piece is brazed from side bar to side bar at about one-fourth the distance forward from the rear axle. The result is an extremely flexible frame, flexible partly from its own spring and partly from its pivoted construction at the joints. The strength of the light steel tubular material is well known and needs no comment. This frame is illustrated in Fig. 2, which will assist in comprehending the foregoing description.

A second important problem in running gear construction is the vehicle axles. The steering axle is relatively an easy problem. It consists of a single drop forging carrying forked shaped ends to receive the swinging bearings on which the hubs are mounted. The slant of the hub pivot may be best described by considering the vehicle to be divided by two central planes at right angles to each other. The lower end of the hub pivot is slightly further from these two planes than the upper end, giving the hub pivot a slope forward and outward. This has two beneficial effects. In the first place the tendency of the wheel so pivoted is to return to a central position if the steering handle should be allowed freedom of motion. The second action is a castor action which renders the steering very much less stiff than would otherwise be the case. The cut, Fig. 3, shows to good advantage this inclination of the hub with reference to the vehicle.

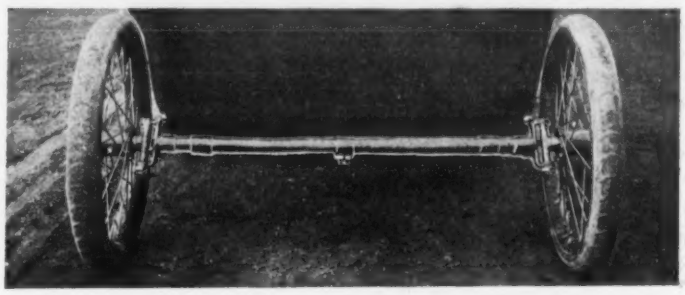

FIG. 2.—TUBULAR RUNNING GEAR OF ELECTRIC RUNABOUT.

The hub pivot has a ball bearing on the top and a cone bearing on the bottom. Wear can be taken up with ease. The hubs themselves are manufactured with both ball and plain bearings. The simplicity and substantial character of plain bearings have, however, caused the company to use them on many of their vehicles, exhaustive tests under severe service strains indicating little practical gain from an anti-friction bearing over a plain taper bearing.

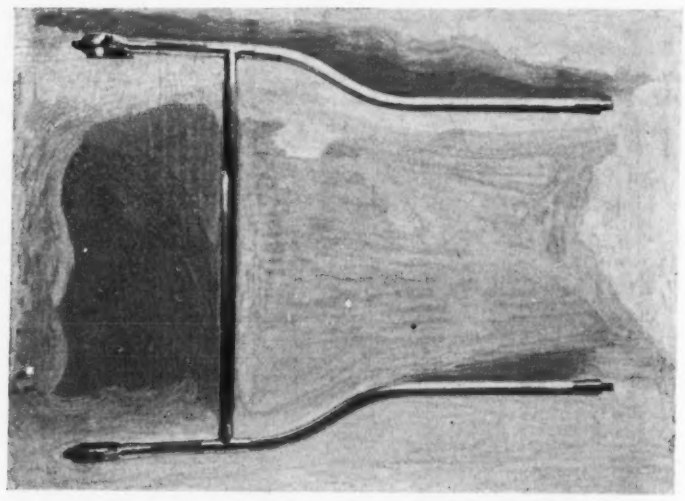

FIG. 3.—SHOWING THE SLOPE OF STEERING HUB PIVOTS.

The driving axle has been a more difficult problem to solve. The company is using both the single and double-motor system, and have manufactured a great many vehicles on the single motor plan. The double motor plan of course involves a stationary axle with the wheels turning freely thereon, and gear driven each by a single motor, but when only one motor is used, it is necessary to provide some form of compensating gear whereby one wheel can turn faster or slower than its mate in rounding curves. A much used device has been to divide the rear axle in two parts and connect them together

by an epicyclic nest of gears, the power being applied to the ring carrying the traveling gears. This necessitated a very strong frame to hold the two halves of the driving axle in exact alignment, and it was found difficult to make this frame strong enough without having it clumsy and cumbersome. The arrangement has, however, been neatly carried out, as shown in Fig. 3. The motor surrounds the rear axle, which passes through the hollow armature shaft. Double reduction gears are very compact, and in other respects the design is very attractive.

The divided rear axle is now avoided by making it stationary and mounting each wheel thereon with its respective gear the same as

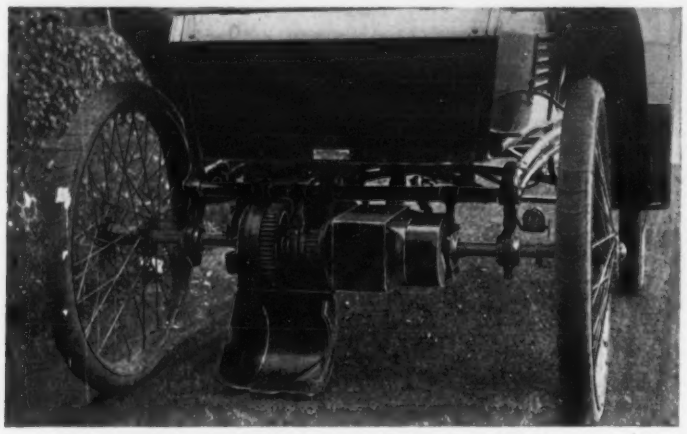

FIG. 4.—DOUBLE-REDUCTION SINGLE-MOTOR EQUIPMENT.

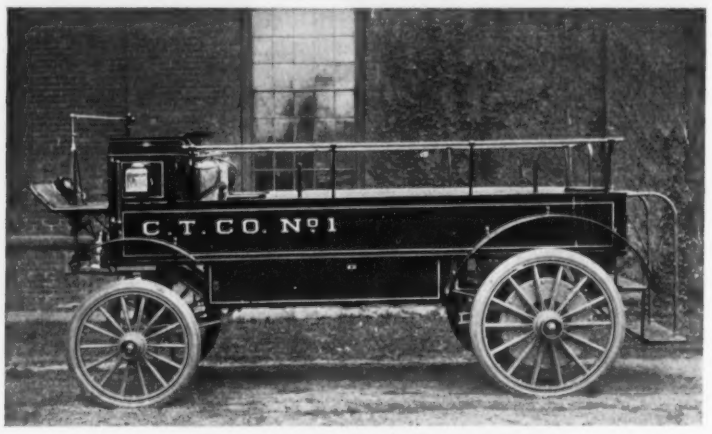

FIG. 5.—EMERGENCY WAGON WITH UNDERHUNG BATTERY.

for double motor propulsion. A single motor with a divided shaft is provided, the armature of which is directly connected with a compensating gear connecting the two halves. Each projecting end of the shaft is provided with a pinion which meshes with the gear mounted on either driving wheel. This device removes the necessity of dividing the rear axle and permits the two driving wheels to have different speeds, even though driven by the same motor and directly geared thereto. The section of this motor shown in Fig. 6 gives an idea of the arrangement. In this drawing the armature details are not shown, the detail being devoted to the sleeving on the shaft and the compensating gear connection. From the cut of the motor shown in Fig. 8 it will be seen that all the mechanism is entirely enclosed within the outer casting, and hence well protected from dust and moisture.

cumbersome. The outer surface of the internal gear is well adapted for the application of a powerful band brake, and the combination which is well depicted in Fig. 7, is neat, compact and attractive.

The company have been doing a great deal of exhaustive experimenting with wheels and tires, and, in fact, are still conducting experiments in that department. The results of these experiments have caused them to adopt the wooden wheel on account of its resiliency, strength, cheapness and convenience in washing. A wooden wheel can be severely dished and will still hold together, but a wire wheel once sprung is likely to fail completely. With regard to tires, the company has found that the solid rubber tire is very durable and economical of power, but it cannot compete with the pneumatic tire in ease of riding. There is a field for both tires, and consequently both are used.

For motor vehicle pinions the company uses both rawhide and steel. Rawhide of course is noiseless and for that reason very much liked, but if it becomes subjected to constant moisture it loses its strength and is likely to strip. The steel pinion, while more reliable in this respect, is also more noisy.

The single motor, which is used on the Columbia vehicles, is a four-pole machine, using a formed coil drum armature. The outer frame is of steel. The commutator is of liberal dimensions and the brush holders are of the reaction type, a carbon brush being used. For self-feeding and operation without attention this combination of brush holder is very desirable. An interesting feature of the single

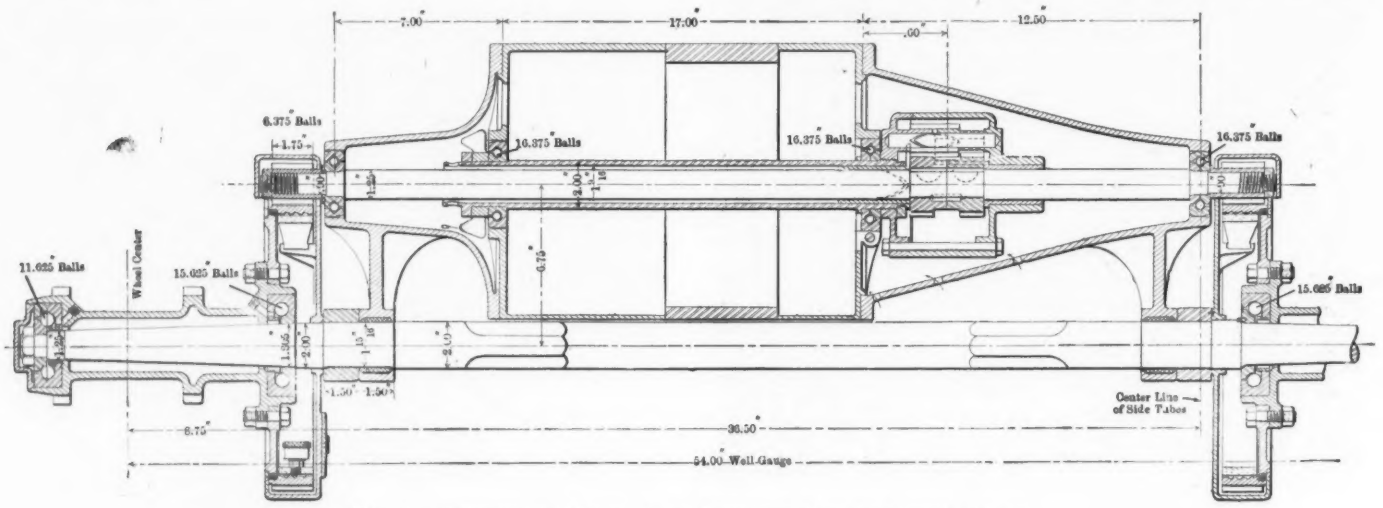

FIG. 6.—SECTION OF MOTOR CASE SHOWING COMPENSATING GEARS.

The suspension of the free end of these double motors is quite interesting. The nose or suspended portion is fastened in the middle to a flat leaf spring supported at its ends by suitable lugs.

If it is desired to drive by the double motor system it is only necessary to substitute two motors for the one and make suitable changes in the controller, no material change in the running gear being necessary. The motor is pivoted by two arms to the axle, which also serves to space the gear and pinion centres and keep the two in mesh.

The company have adopted the internal driving gear for several reasons. In the first place it is self-contained and there is only one surface to protect, thereby making the housing much lighter and less motor consists of a little fan mounted on the motor axle and revolving with it. This serves to draw air in through small ventilating holes and forces it through the windings, a device which enables the motor to carry large overloads.

The single motors are illustrated in Fig. 8, and are also of the four-pole type. They are interesting on account of the construction of the field frame, which consists of stamped laminæ bolted together by suitable end rings carefully designed. These motors have an exceedingly high efficiency, all of them ranging over 85 per cent. At present the company is not making its own motors, but they are supplied according to exacting specifications by the large electric

manufacturing companies and all of them are rigidly tested before being placed on the vehicles.

On looking through the factory one sees a great many motors of different makes which have been tried by the Columbia Company; in fact, the policy of this company has been to exhaustively investigate any device which might prove of value to them, and from the aggregation to select the best, and particularly has this been the fact with regard to motors and batteries. It is therefore a very satisfactory guarantee to the user of the vehicle to know that the design has thus passed through the furnace of criticism.

The company has devoted a great deal of time to development of the controller and have fixed on a type giving three speeds forward and two backward. The vertical position of the controller handle is the off position. To throw it on the backward speed it is necessary to unlock a little foot latch. A button in the top of the handle rings the vehicle gong and thus with one hand and a foot the operator can control the forward or backward motion of the vehicle.

The new controller contains all of the valuable features of the old controller and several new ones of great merit. The new controller has three speeds forward and three speeds backward, the operation being as follows: The forward movement of the handle gives the forward speeds. By turning the controller off and pressing a foot latch the forward movement of the handle will then give backward speeds. As soon as the controller handle is returned to "off" the foot latch flies up automatically and further motion of the handle gives forward speeds once more.

The controller cylinder is of wood mounted on a steel axle. On the surface of the wood cylinder are screwed the contacts which pass under the fingers and these contacts are suitably interconnected among each other by straps or wires. The controller fingers, eleven in number, press upon these contacts. Their pivot consists of a common bar running the length of the controller. A fibre sleeve insulates the fingers from the bar and fibre washers insulate the fingers from each other. The fingers themselves are very long and extend from the pivot bar and carry about midway a little shoe which bears on the contacts. Between the shoe and the pivot is an adjusting screw which bears upon a little steel stud set in a heavy vulcabeston piece running the length of the controller. By varying this screw the amount of pressure of the fingers on the contacts can be readily adjusted. The extreme end of the finger carries a powerful helical spring, which is in a very convenient position for removal and renewal. In the finger itself is cast a lug, into which is soldered the connecting wire. This obviates all loose joints in the electric circuit from motor or battery to controller, a very valuable feature. Moreover, by simply unloosening the spring the controller finger can be unhooked and removed either for repolishing its face or for replacing a worn-out finger. The notch-wheel is mounted on the same shaft as the controller, and the motor-roller is mounted on a finger differing only slightly in shape from the controller finger and subject to similar strong spring tension. The reverse cylinder is mounted on a sleeve on the same shaft as the controller cylinder proper. The finger and plate construction are the same and an interlocking gear is provided which prevents improper manipulation of the controller. The controller shaft is mounted in arms which are cast on to a frame plate and on the end of the shaft is a small pinion which meshes with a sector of considerably larger radius, which is pivoted on a shaft in the supporting plate, and on this latter shaft the handle is mounted. The object of this is to enable a large movement of the controller cylinder with a slight movement of the handle. It is not convenient to the operator for the handle to swing over an arc exceeding 60 degrees, and to properly make contacts in the controller it is necessary for the cylinder to swing over an arc of at least double that amount, and hence the gearing becomes a very convenient feature.

The speed control is obtained on some carriages by battery commutation alone; on others by battery commutation and series-multiple motor arrangements. No resistances are used, and this is true whether a single or double motor equipment is provided. The motors are all series wound and their control is therefore very simple.

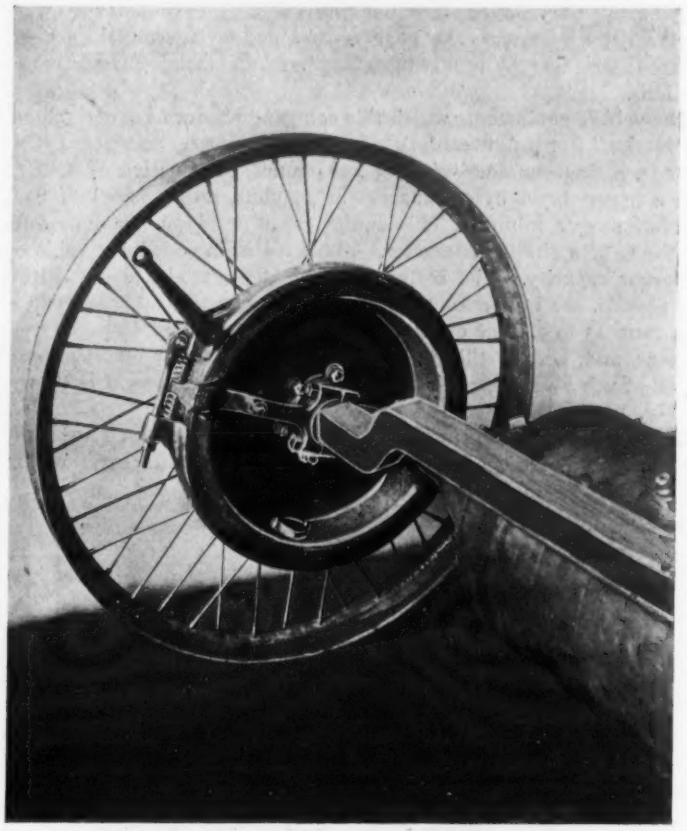

FIG. 7.—INTERNAL GEAR HOUSING AND BAND BRAKE.

After exhaustive trials of batteries of almost every conceivable make, the company has adopted a cell made by the Electric Storage Battery Company, of Philadelphia, Pa., as being the best suited to their work. These cells are used in batteries of 44, 42 and 40 cells. The position of the batteries in the vehicle has recently been the subject of some experiment. In many of the delivery wagons and in fact some of the passenger vehicles the device of underhanging the battery has been tried, that is to say, supporting the battery by slings underneath the body of the vehicle proper. This has the advantage of making a lighter vehicle than when the battery has a separate compartment, and it is also convenient when loading the batteries on the vehicle. Further than that, when the vehicle is charged with the

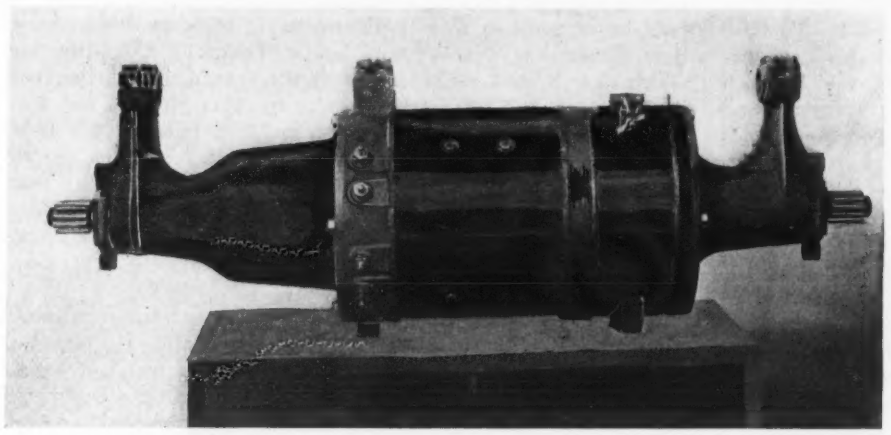

FIG. 8.—PERSPECTIVE OF SINGLE MOTOR.

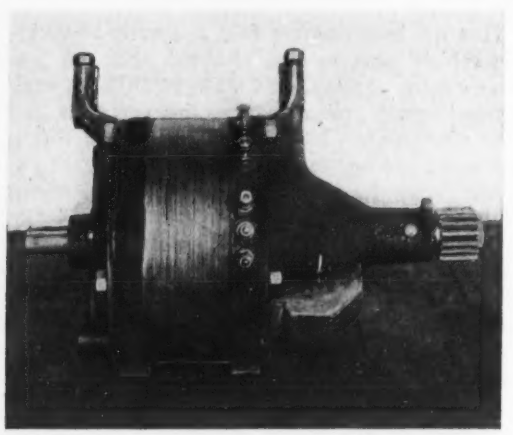

FIG. 9.—MOTOR FOR DOUBLE-MOTOR SYSTEM.

battery in place the ventilation is better and corrosive fumes are less liable to damage. Fig. 5 illustrates an emergency wagon with an underhanging battery, from which it will be seen that the device can in many cases be used without marring the appearance of the vehicle or causing it to look clumsy or cumbersome. In electric cabs and vehicles of kindred character the batteries are made with automatic contacts at the sides, so that slipping a battery into place makes its contacts as well. In other vehicles, however, contact is made by slipping a plug-shaped terminal into a clamp contact screwed on the battery crate. The positive and negative terminals are of different size, thereby rendering it impossible to make incorrect connections.

The vehicle equipments which this company produce are designated by "Marks." For instance, Mark III consists of a battery weighing 1100 pounds, a single motor weighing 230 pounds, a reduction of 8 to 1, and a motor input of 25 amperes at 75 volts, and a speed of 800 revolutions per minute. This equipment is used on phaetons and carriages of a similar character. Mark XI is intended for vehicles of larger capacity. The battery weighs 1390 pounds, single motor 310 pounds, the motor input 40 amperes at 75 volts, and the reduction ratio 13 to 1. The equipment Mark XI is also used on delivery wagons, and, with a still larger battery, is suitable for omnibus purposes. Such a vehicle equipped with a Mark XI equipment is shown in Fig. 10.

The smallest equipment shown as Mark XII and used in Runabouts and Victorias, has a battery of 700 pounds, single motor weighing 140 pounds, a reduction ratio of 8¾ to 1 and a motor input of 20 amperes at 75 volts. The type of motor used is shown in Fig. 8.

That the long distance field is shortly to be invaded by the electric vehicle must be also admitted. Fig. 11, a Columbia long distance electric phaeton, with a 100-mile radius, depicts a vehicle which outrivals many steam and gasoline carriages in neat, compact and light appearance. It is interesting to add that this carriage holds the world's record for a long distance run for electric vehicles. An article giving the details of this record trip appeared in these columns in the issue of Dec. 23, 1899.

The Columbia & Electric Vehicle Company have exploited the electric automobile, which has so far proven the most commercial and satisfactory vehicle that they have yet produced. They are experimenting with vehicles using other propelling powers, which no doubt will find a sale in the fields for which they are suited, but the present output, which has crowded their facilities to the utmost, is principally although not exclusively electric, and as they state they are far behind their orders it certainly would appear that the electric vehicle has an exceedingly strong hold on the commercial field, and for many purposes, as is well known, nothing can replace it. The vehicles manufactured by the Columbia Company are made exclusively for the Electric Vehicle Company, New York, through whom they are distriguted to various sub-companies throughout this country and Europe.

The Death of Mr. James Hamblet.

Last week we noted briefly at the hour of going to press the death, on Jan. 2, of Mr. James Hamblet, in his seventy-fifth year, after but three days of illness, due to pneumonia. The funeral services took place in Brooklyn on Jan. 4, being largely attended by officials of the Western Union Telegraph Company, the Brooklyn Institute, the American Institute of Electrical Engineers, the New York Electrical Society, and other bodies. The interment is in Woodlawn Cemetery, Boston. Mr. Hamblet left a wife and daughter, the latter having for some time past assisted him in his time registration duties.

THE LATE MR. JAMES HAMBLET.

Mr. James Hamblet was born at Boston, Mass., on June 16, 1824. His first position was with Wm. Bond & Son, the celebrated astronomers, with whom he was associated from 1853 to 1862, when he went into business in Boston for himself, continuing until 1870 in the manufacture of general electrical apparatus and telegraph instruments. He then joined E. Howard & Company, the clockmakers, staying with them until 1876, when he went to California for the Electrical Construction Company. A year later he returned to New York, where, in 1878, he established the time service for the Western Union Telegraph Company, since which time he had entire charge of the system, introducing many improvements and refinements previously unknown. He was a man of wide acquaintance and larger sympathies. During his Boston career he became intimate with Mr. Edison, then a young operator, and took the deepest interest in his achievements. The ELECTRICAL ENGINEER printed, a year or two ago, an old article by Mr. Edison describing the Boston electrical and scientific instrument makers of his day, the original manuscript, some thirty years old, being loaned us by its proud possessor, Mr. Hamblet.

In all public duties the deceased was active and self-sacrificing to a degree that militated against his private welfare. He served the American Institute of Electrical Engineers loyally for some years as manager and vice-president, took an active part in the work of the New York Electrical Society, and presided most efficiently over the Electrical Section of the Brooklyn Institute. He was also an interested member of the Old Time Telegraphers' Association. A devout Christian, a keen, inventive electrician, an accomplished horologist, a true friend, a man of kindliest disposition and widest sympathies, James Hamblet was one of those who leave the world the better for their living in it.

FIG. 10.—ELECTRIC OMNIBUS.

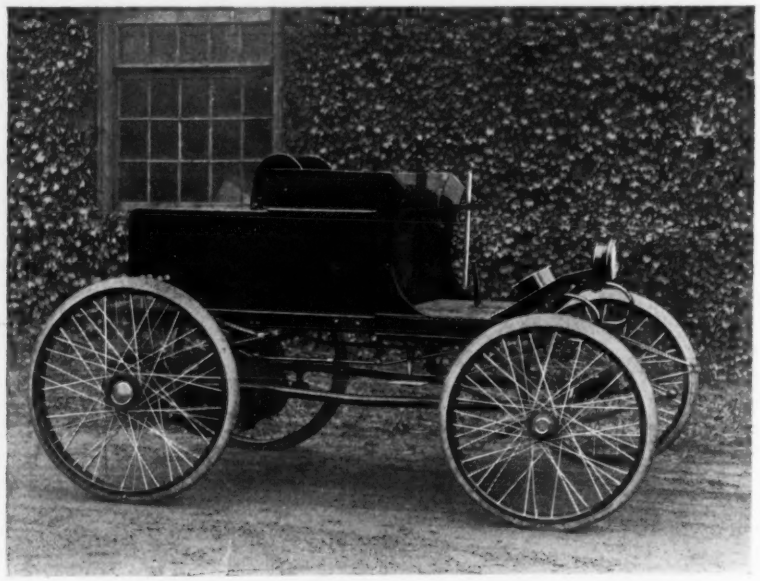
FIG. 11.—LONG DISTANCE ELECTRIC PHAETON.

Municipal Lighting and Sewerage Plant, Concord, Mass.

The power station erected by the town of Concord, Mass., which is now nearly ready for operation, is a good example of the better type of municipal plants in New England. The equipment throughout has been planned with the one object of efficiency in view. No expense has been spared to make the plant as nearly as possible automatic in its operation. The installation is a small one, and no great increase is anticipated in its capacity for years to come. Such refinements as might seem almost necessities in a metropolitan plant, for instance, were obviously needless in this case, their economy being limited at a certain point in the range of capacity of a station.

Perhaps nowhere in this part of the country are wages higher than in the eastern states for such work as is involved in central station lighting and power supply. The general tendency is therefore to reduce the high cost of labor and superintendence, in any particular instance, by getting along with the least possible amount of either. This has been one object at the Concord plant.

The system embraces a complete sewerage connection for the centre of the town, the drains being headed and carried to a surge tank and from there pumped through a filter bed to the river. This much was a necessity, and it was a short step to decide to even the load on the power plant which would be required by installing electric lighting apparatus.

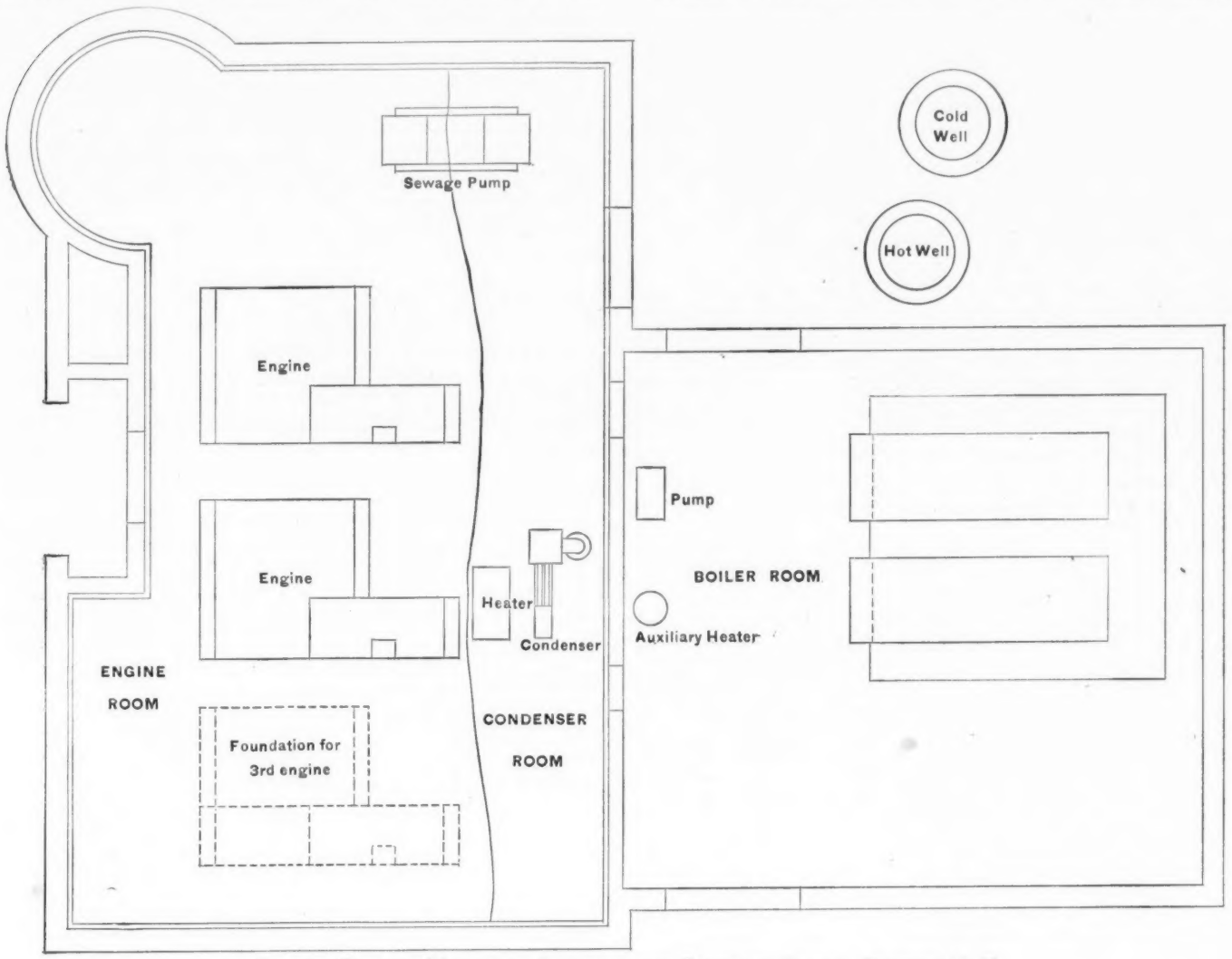

FIG. 1.—PLAN OF MUNICIPAL LIGHTING AND SEWERAGE PLANT, CONCORD, N. H.

The power station is of brick, with pressed brick trimmings and wood-truss roof construction. Fig. 1 shows the general arrangement of the apparatus. The chimney is brick, round cored. A covered way leads from the coal and storage sheds to the boiler room. A side track from the B. & M. railroad terminates opposite the former. The boiler room is five feet below the engine room, and six feet above the basement containing the heater and condenser. A 12-inch brick wall separates the two parts of the building, and communication is provided from both engine room and boiler room to the basement.

The boilers rest on an I-beam framework, entirely independent of the brick setting. They are of the horizontal tubular type, built by the Holyoke Steam Boiler Works of Holyoke, Mass., to the following specification: Diameter, 66 inches; 92 3-inch tubes, 16 feet long; overhanging fronts. Each boiler is fitted with two 3-inch pop safety valves mounted on a special casting from the rear nozzle; with two 11 by 15-inch manholes, cast-iron fronts, and Tupper grates. The pressure carried is 125 pounds.

The two engines are tandem compound, condensing, of 125-hp each, built by the Harrisburg Foundry & Machine Works. They run at 300 revolutions per minute, at a normal pressure of 120 lbs, and are of the four-valve type. Each engine is direct connected to a 75-kw, 1100-volt Westinghouse two-phase generator, the whole outfit in each case being on one bed plate. They will operate 100-volt lamp and motor circuits through transformers.

The engine for the sewerage system is a compound simplex Blake pump, 7 and 14 by 11 and 12 inches The steam connections for operating this pump are shown in Fig. 2. By means of the cocks *A* and *B* the work can be handled by one or both cylinders, and the pump can be run as either a double or compound engine.

Additional equipment includes a marble switchboard, feed-pump, injector, Blake condenser, and primary and auxiliary heaters. It is in the arrangement of this auxiliary apparatus that the promised economy of the plant mainly consists. Perhaps no part of a power station is so delicate a matter to handle as the piping and heating systems. The entire steam equipment of the station exclusive of the boilers and engines, was in this case embodied in the piping contract, and can be best described as a system complete in itself, forming one harmonious whole.

Steam is taken from the forward nozzles of the boilers. Two 4-inch pipe bends carry it to the main valves, located next the horizontal portion of the bends. From the valves, two additional bends lead to the top of a 7-inch gun metal header, cast in two pieces, with a valve at its centre. All steam supply lines are also taken from the top of the header, no separators being used.

A 3-inch pipe leads to a tee, from which steam for the pump, injector, sewer pump and condenser is taken. Pipe bends, four inches in diameter, run to the main engines.

The exhaust pipes from the two engines, eight inches in size, run into a 12-inch main connecting with the feed water heaters, the arrangement being as shown diagrammatically in Fig. 3. The two engines can be run in a variety of ways: i. e., either one condensing, either one non-condensing, one condensing, and the other non-condensing, both condensing, both non-condensing, thus giving eight possible combinations. The exhausts from all auxiliary apparatus can be run either to the auxiliary heater or into the main free exhaust beyond the relief valve. Steam and exhaust pipes as far as the heaters, and all hot water pipes, are covered with Nonpariel cork. The boilers are coated with magnesia cement.

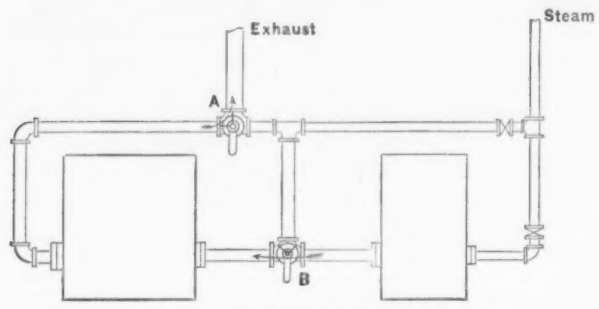

FIG. 2.—PLAN OF ENGINE STEAM PIPING.

The condenser suction water is taken through an 8-inch main from the cold well, just outside the building, and the discharge pipe is carried to the hot well. Water for boiler feed can be taken from either the cold well or the hot well by either the pump or the injector. When the pump is in operation, the water from the hot well will be forced through both the primary and the auxiliary heaters, and a very high temperature should be attained.

The entire steam system is dripped and the condensation returned to the boiler by the Holly gravity return apparatus. This consists of a receiver, into which the drips are carried by gravity, a reducing valve, producing a partial vacuum on the suction side of the separator, and the separator itself, which accummulates the condensation at a point sufficiently elevated above the boiler water line to give the column a pressure sufficient to force its way to the boilers.

The oil used for the machinery in the station is drained into a

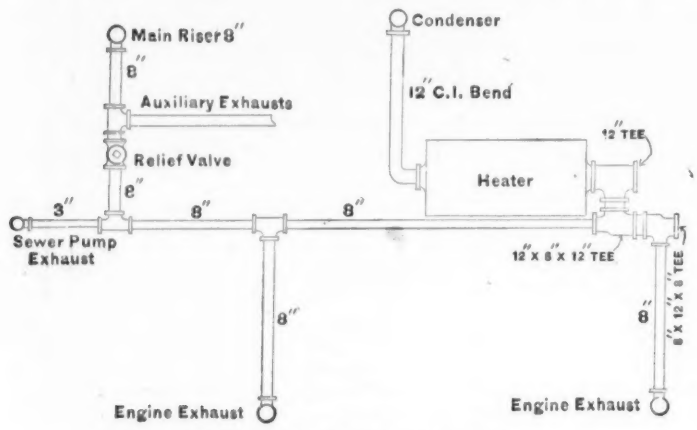

FIG. 3.—PLAN OF EXHAUST PIPING.

receiving tank in the basement, from which it is pumped to a supply tank through a filter, and is thence run through the engine bearings repeatedly.

The main points from which high economy is anticipated are the following:

Pipe bends instead of fittings are used to reduce friction and loss of steam pressure in the piping. All condensation is returned to the boilers. The feed water will be delivered to the boiler at a very high temperature. No oil will be wasted. The load will be uniform from dark until daylight. The equipment can be adjusted to correspond very closely with the load. Coal and supplies will be delivered at the door. Water costs nothing, and is of good quality. One man at a time, it is expected, will operate the entire plant.

What is probable economy attainable under these conditions? It is fair to assume that the boilers under actual conditions of temperature and pressure, with skilful management, will evaporate 8¼ pounds of water per pound of coal. The engines, operating under uniform conditions, condensing, will require from 16 to 18 pounds of dry steam per horse-power. The generators, at full load, should display not less than 93 per cent. efficiency. From this data, a theoretical efficiency of about 3.1 pounds of coal per kilowatt would result. Reducing this, however, are several indeterminable factors, such as unavoidable losses from radiation and condensation, wastes in starting and stopping, etc. It seems fair to expect that under favorable conditions an economy of four pounds should be maintained.

When completed, a working test of the plant will be made by Messrs. Stone and Webster, of Boston, electrical engineers, who designed the entire equipment.

Three Wire Distribution from One Machine.

BY EDWARD BRETCH.

IN the distribution of electricity for lighting, by direct current any considerable area is usually covered by the three-wire system. The most common arrangement is by the use of two machines. If one machine could be made to successfully operate such a system, keeping the pressures equal on the two sides, without employing apparatus too complicated, there are many cases where such a system could be employed to great advantage.

Take, for instance, a factory that is being supplied with current from a central station employing the three-wire system. If this factory wished to install a machine of its own, the entire wiring would have to be remodeled. If the wiring is changed, the lights cannot be thrown on the central station in case of a breakdown. By using two machines all would work out well, but unless the installation was quite large two machines would be out of the question.

Since the 220-volt lamp has proved a success, such a system could also be employed in small towns as a central station system, combining partly the advantages of the alternating with the direct current system, with no transformer losses and better motor service. With alternators of the size usually used in such plants, motors of large size would be somewhat unsatisfactory. A system at 440 volts would give a combination of a standard lighting system and a standard power system from one machine.

It might be said that, in the case above, the ordinary three-wire system would be the one to employ. It is true it could be used, but with two machines, as in the ordinary arrangement, both would have to be running to make the system complete, whether the load was light or heavy. On the other hand, with one machine units and two machines, one could be larger than the other, the smaller being for light loads and larger for the medium loads, and both together for heavy loads. The machines could then be operated at all times close to their rated capacity, and consequently at greater efficiency. This arrangement would also allow more time for repairs and care of the machinery, and by the use of double voltage would lessen commutator troubles.

Now comes the question as to how this is to be done. It is evident that by some means we must have the neutral wire connected to a point whose potential is midway between that of the outside mains. If we connect any point on the winding of the armature to a slip ring and the neutral wire to this through a suitable choke coil, we will in a way have accomplished it. But this arrangement is not a practical one for several reasons. If much current flowed through the neutral wire and the choke coil, the core of the coil would be magnetized to saturation, which would destroy its effect somewhat as a choke coil. Besides, any great amount of current taken from the armature through the slip ring would cause serious complications in the armature.

Using two points on the armature 180° apart and having the choke coils on a common magnetic circuit will give better results, and is a practical arrangement, machines having been installed on this plan. As will be seen, the magnetizing effect of the current flowing in the neutral wire will be eliminated, since the current will divide, half circulating around the core one way and half the other way through an equal number of turns. None of the alternating component in the choke coil will now find its way out on the line, and the current in the neutral wire having two points to enter the armature will distribute itself more evenly in the armature, causing less interference.

The use of three points 120° apart and three slip rings gives a still better arrangement. The three alternating currents drawn

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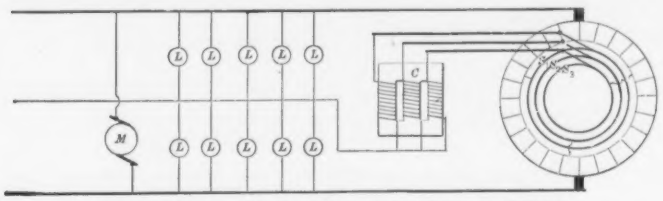
from the armature to magnetize the core of the choke coil will have a less disturbing effect on the armature; and the current in the neutral wire having more points to enter the armature will distribute itself still more evenly, causing still less interference. The choke coils, as before, having a common magnetic circuit, the magnetizing effect of the direct current flowing in the neutral wire will be eliminated.



THREE WIRE DISTRIBUTION FROM ONE MACHINE.

Assuming that the alternating current follows the sine law, if we have a number of currents, denoted by n, which have a phase displacement of $\frac{360 \text{ degs.}}{n}$ from each other, the effect on the armature is the same as in the case of three-phase currents; that is, the reactions on the armature will be constant both as to magnitude and direction. By increasing the number of points on the armature to which we connect the neutral wire through a system of choke coils with a common magnetic circuit, the effect produced in the armature by the alternating currents flowing through the choke coils will remain constant, both in direction and magnitude, and the effect produced by the direct current in the neutral wire entering the armature at the various points, tends more and more to be constant in both directions and magnitude as the number of points increase, being practically constant when each coil of the armature has a connection to the neutral wire.

Mechanically, the apparatus should be as simple as possible; electrically, the effect produced on the armature should be constant, both as to direction and magnitude, so as not to interfere with the commutation. Connection to one point is best mechanically, but electrically it is out of the question, while connection to every coil is best electrically, but as much out of the question mechanically. Therefore, for the best results we must select something between these two extremes that will in a way combine the advantages of both.

The use of three points, as shown in the figure, seems to most nearly combine the advantages of both extremes. It is not complicated; the alternating current drawn from the armature by the choke coil produces a constant magnetic effect on the armature as to direction and magnitude, and the number of points through which the current enters from the neutral wire is sufficient to keep the armature very nearly in electrical balance in all positions.

Therefore, it would seem that where conditions make it desirable to operate a three-wire system from a single machine, the system as just outlined would be the most satisfactory one to employ. The accompanying figure diagramatically represents such a system.

Niagara Power Substations for Buffalo Electric Railway Service.

The new Niagara power feeder stations for the Buffalo street railway system in course of construction are of special interest to those in railway work. There are four substations for supplying Niagara current to the various street railway feeders. The Seneca and Elk Street station and those at Cold Spring and Walden Avenue are about completed, and a fourth station at Eagle and Jefferson Streets is in course of construction.

The Seneca and Elk Street feeder station has two rotary converters, as shown in Fig. 2, each of 500-hp, and delivering to the feeder switchboards a direct current of 695 amperes at 575 volts. These rotary converters receive three-phase currents at 360 volts and a frequency of 25 cycles. The speed is 500 revolutions per minute. The armature journals are reciprocated in their bearings by the usual magnetic device, thus avoiding wear in ridges and keeping the bearings and commutators perfectly smooth.

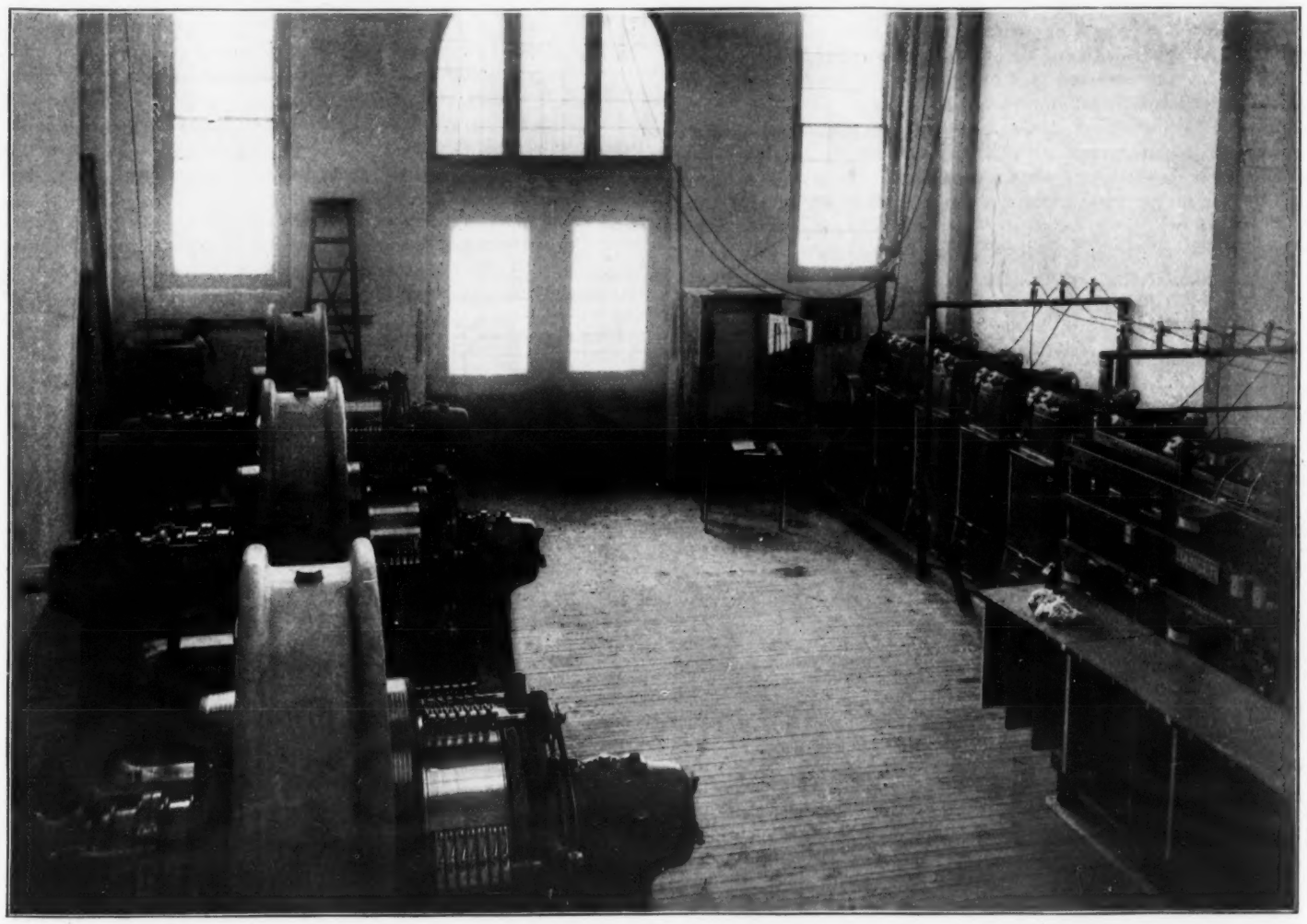


FIG. 1.—BUFFALO—COLD SPRING POWER PLANT.

The three-phase currents are reduced in pressure by two sets of step-down transformers, three being in each set. The currents are delivered to them at 10,500 volts primary and reduced to 375 volts in the secondary at 25 cycles. In the illustration of Fig. 3 may be seen at the extreme left the blower which supplies air for the cooling of the transformers. The blowers are two in number and are each operated by a 2-hp direct-current motor at a speed of 325

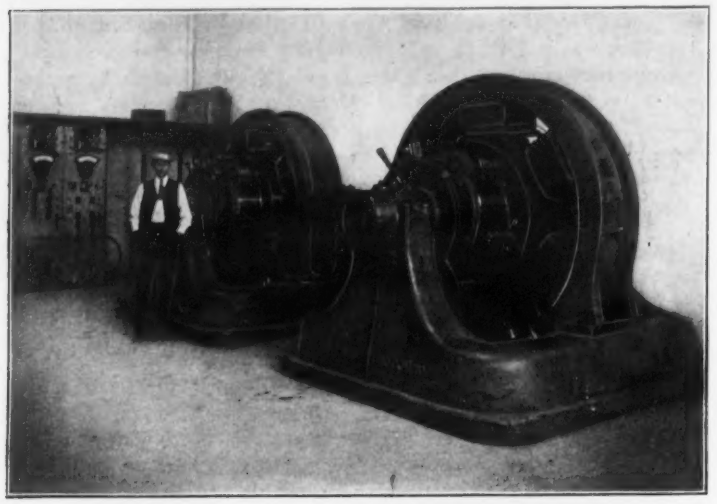


FIG. 2.—SUBSTATION ROTARY TRANSFORMERS.

revolutions per minute. The current required is 3.5 amperes and is supplied from the 575-volt railway circuit.

The Walden Avenue substation has two rotary converters of the same type for supplying direct-current to the street-railway feeders, and is also equipped with six step-down transformers, as before described. The same size and type of equipment will be placed in the Eagle and Jefferson Street station.

The Cold Spring power station, illustrated in Fig. 1, is equipped with three 500-hp rotary converters and nine step-down transformers, each set of three having a capacity of 500-hp and each supplied by one of the three-phase currents. The direct current from the three rotaries is conducted to three panels situated at the right of the front of the switchboard. On these three panels are mounted three G. E. circuit breakers for protecting the rotaries, and three Thomson ammeters, whose readings are taken at intervals by the attendant and carefully recorded.

The current to the feeders is controlled by six panels at the left, each supplied with its circuit breaker. The voltage is indicated by the instrument in the centre panel, while below is placed the wattmeter.

The permanent high-tension switchboard has not been completed, a

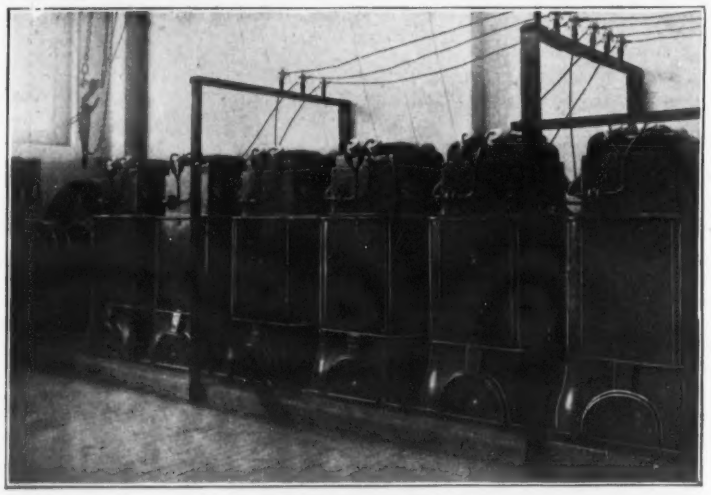


FIG. 3.—SUBSTATION STATIC TRANSFORMERS AND BLOWER.

temporary affair taking its place for the present. It will be placed near the wall at the right, and will consist of three panels on the floor level and one above, on which latter will be mounted the high-tension circuit breakers.

All these improvements are reported to have cost the International Traction Company fully $1,250,000, and the company is preparing to spend as much more in the coming year.

Buffalo is to-day the centre of a wide-reaching system of electric railways which is more than local in its character. The International Traction Company owns, through subsidiary companies, all the lines in Buffalo, the four lines running to the Tonawandas, the lines to Niagara Falls, the lines to Suspension Bridge, the Canadian line along the bank of the river from Chippewa to Queenstown, the upper and lower bridges across the Niagara River at and below the falls, the line to Lockport, the lines in Lockport (it will also build a line from Lockport to Olcott in the spring), and the line to Depew and Lancaster.

The companies owning and operating these various properties are the Buffalo Railway Company, the Buffalo Traction Company, the Crosstown Street Railway Company, the Buffalo, Bellevue & Lancaster Company, the Buffalo & Lockport Company, the Buffalo, Tonawanda & Niagara Falls Company, the Niagara Falls & Suspension Bridge Company, the Niagara Falls Park & River Company, the Lockport Company and the two bridge companies. All these companies are in active existence and each one operates its own plant. The International Traction Company is not an operating company, but owns the securities of these companies. It is represented on their respective boards by W. Caryl Ely as president, Burt Van Horn as general manager, and R. F. Rankine as treasurer and secretary.

Compensation of Line Drop in Alternating Current Circuits.

BY E. J. BERG.

TO illustrate the practical application of the general equation (see footnote) expressing the relation between currents and e. m. f. in an alternating current system, assume a single-phase system in which it is desired to transmit 1000-kw at 60 cycles with 10,000 volts at the receiving end of the line. The length of transmission is twenty miles and the energy loss with non-inductive load about 10 per cent.; the load is, for simplicity's sake, assumed to be non-inductive.

In order to determine the constants in such a system, the size of wire, the reactance and capacity have to be calculated in the usual way. Since, however, with an overhead construction at 10,000-volts the capacity effect is very small, it can be neglected.

$$\text{Line current} = \frac{1000000}{10000} = 100 \text{ amperes.}$$

$$\text{At 10 per cent. loss, } I^2R = 100000, \text{ thus } R = \frac{100000}{10000} = 10 \text{ ohms.}$$

$$\text{Therefore ohms per mile} = \frac{10}{40} = .25,$$ which corresponds to No. 0000 wire. This wire has .26 ohms per mile, therefore the resistance of transmission line is 40 x .26 = 10.4 ohms.

The general equation giving relation between currents and e. m. fs. in an alternating current system is expressed in complex quantities in equation (A):

$$E_0 = E + (i + ji_1)(r - jx)$$

where:

E_0 = generator voltage,
E = voltage at receiving end of transmission,
i = energy component of current,
i_1 = wattless component of current, which may in its turn be expressed as $i_2 - i_3$, where i_2 is the lagging component, and i_3 the leading component;
r = resistance of transmission line,
x = reactance of transmission line.

This equation is essentially the same as in a direct current circuit, and consists of three terms: The first, the e. m. f. generated; the second, the e. m. f. at the receiving end, and the third, the drop in voltage in the line. The only difference is that in an alternating current circuit the drop is expressed as:

$$(i + ji_1)(r - jx)$$

whereas in a direct current circuit, it is simply ir.

Solving equation ("A") in reference to i_1, the wattless component of current, and substituting the real values of E_0 and E as e_0 and e, we get:

$$i_1 = \frac{-ex}{z^2} \pm \sqrt{\frac{e^2x^2}{z^4} - \frac{2eir}{z^2} + \frac{e_0^2 - e^2}{z^2}} \quad \text{.....(B}$$

With non-inductive receiving circuit i_2 is zero and $i_1 = i_3$ thus represents the leading or condenser current:

$$\text{Thus } i_3 = \frac{ex}{z^2} - \sqrt{\frac{e^2x^2}{z^4} - i^2 - \frac{2eir}{z^2} + \frac{e_0^2 - e^2}{z^2}} \quad \text{.....(C)}$$

neglecting the + sign for the square root since the value corresponding thereto is of no practical value.

This last equation enables us to calculate how much leading current is necessary in order to obtain any desired relation between the generator voltage and the voltage at the receiving end—that is between e_0 e, in systems of non-inductive receiving circuit.

The reactance per 1000 ft. of wire is found from the following equation:

$$x = 2\pi n \times \frac{30.5}{10^6}\left(2\log\varepsilon\frac{2L}{d} + \frac{1}{2}\right)$$

where:

x = reactance per 1000 feet of wire.

n = frequency.

$\log\varepsilon$ = natural log $= \frac{\log_{10}}{.434}$.

L = distance between wires.

d = diameter of wire expressed in same units as the distance.

Assuming 18 " distance between wires, wet get:

$$x = \frac{5.28 \times 40 \times 2\pi 60}{10^6} \times 30.5\left[2\log\varepsilon\frac{36}{.46} + \frac{1}{2}\right] = 22.5 \text{ ohms.}$$

Impedance of line is $z = \sqrt{10.4^2 + 22.5^2} = 24.8$ ohms.

The generator voltage at non-inductive load is obtained directly from equation (A), or

$$e_0 = \sqrt{(e + ir)^2 + i^2x^2} = \sqrt{(100000 + 100 \times 10\ 4)^2 + 100^2 \times 22.5^2}. \text{(D)}$$

or the generator has 13 per cent. higher voltage than the receiving end of the line with 10.4 per cent. energy loss, and no compensation of line drop.

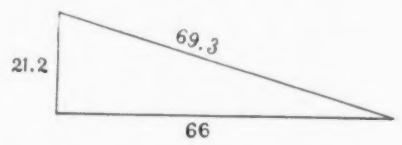


FIG. 1.—RELATION OF CURRENTS.

If it is desired that the generator voltage and the voltage at the receiving end shall be the same—that is, to compensate for the entire line drop—the value of i_s, the leading current, is obtained directly from equation (C) and is

$$i_s = 10000 \times 22.5 - \sqrt{\frac{(225000)^2}{615} - 100^2 - \frac{2000000 \times 10.4}{615}}$$

= 66 amperes, or 66 per cent of the full load energy current.

In other words, the condenser should be of such size that it will take 66 amperes when connected across the 10,000-volt mains, or be of 660-kw capacity. Since a synchronous motor can be used as condenser by over-exciting its field, a synchronous motor can be substituted for this condenser.

Such synchronous motor should have a current capacity of 66 amperes and be wound for a potential of 10,000 volts. That is, it should also be of 660-kw capacity. Its field should be so much over-excited that while running light, that is, carrying no load, its current should be 66 amperes.

If there is no margin in current capacity, it is possible to put any mechanical load on the motor and at the same time obtain this potential control. Were there, however, only a slight margin, considerable load could be carried. For instance, if the current capacity were 5 per cent. larger, or 69.3 amperes, the motor could carry a load corresponding to 21.2 amperes or 212-kw, as obtained from the diagram of Fig. 1.

With 10 per cent. increase in current capacity a load of 303-kw can be carried, and with 15 per cent. increase in current capacity, a load of 375-kw.

That is, with 5 per cent. increase in current over that necessary to obtain phase control, a load of 31.6 per cent of the synchronous motor rating can be carried; with 10 per cent. increase in current a load of 45 per cent., and with 15 per cent. a load of 56.6 per cent. of the synchronous motor rating can be carried.

Or, vice versa, if a fully loaded synchronous motor is available in a system where phase control is desired, a compensation of lagging currents of 31.6 per cent, 45.8 per cent and 56.6 per cent., respectively, of the current capacity of the motor can be obtained by over-exciting the motor so as to take 5 per cent., 10 per cent. and 15 per cent., respectively, more than full load current.

Such synchronous motor acts within a fair limit as an automatic compensator, since as the load increases the line drop increases—that is, the voltage at the motor terminals decreases—and therefore if excited from a source of constant potential, and thus giving constant counter e m f, it takes more and more leading current, which is desirable. Since, however, this feature depends upon the armature reaction and magnetic condition—that is, the saturation of the motor—it is impossible to deal with it except in each particular case.

As stated above, however, the control is often close enough without change of excitation of the motor; at the same time, if perfectly constant voltage is desired, the excitation has to be increased with the load.

If it is desired to have the synchronous motor over-excited so as to make the receiving voltage 5 per cent. higher than the generating voltage, the corresponding value of wattless current i_s is obtained from the same equation (C) by substituting for $e_0 = .95e$, as follows:

$$i_s = \frac{225000}{615} - \sqrt{\frac{(225000)^2}{615} - 100^2 - \frac{2000000 \times 10.4}{615} - \frac{10000000}{615}}$$

= 95 amperes.

That is, the wattless leading current is 95 per cent. of the full load energy current.

In other words, a compensator or synchronous motor of 95 per cent. capacity of the load would be necessary to accomplish this.

The distribution of potential along the line in such a system can be obtained by considering the generator placed in the various points under consideration; in other words, by solving the equation by inserting proper values of r and x corresponding to distances between receiving station and the point of the line under consideration.

Thus, for instance, in the first case, when the voltage at generator and receiving end of line is the same, at one-quarter of the distance counted from the receiving station,

$$r = \frac{10.4}{4} = 2.6,\ x = \frac{22.5}{4} = 5.62.$$

$$e_0 = \sqrt{2^2(i_s^3 + i^2) - 2e(i_s^3 x - ir) + e^2} \text{.....(E)}$$

$$= \sqrt{38.3(4350 + 10000) - 20000(370 - 260) + 100000000}$$

= 9925 volts.

In a similar way, by inserting other values for r and x, is found that:

At 10 per cent. distance from receiving station, e_0	= 10000
20	9930
30	9900
40	9880
50	9880
60	9880
70	9900
80	9920
90	9950
Generator	10000

It is of interest to note that the voltage all along the line is less

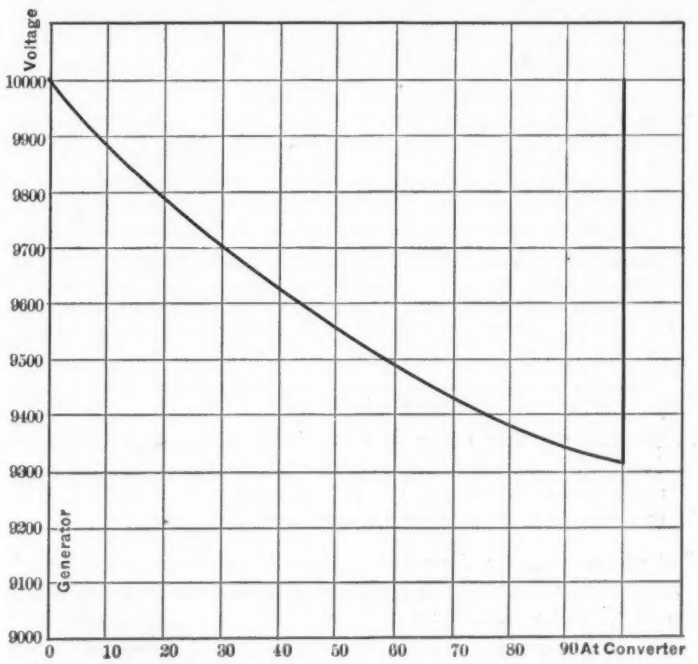


FIG. 2.—DISTRIBUTION OF POTENTIAL ALONG A LINE OF 10.4 OHMS RESISTANCE AND 22.5 PER CENT. REACTANCE WITH 15 PER CENT. ADDITIONAL REACTANCE AT CONVERTER.

than at the generator and at the receiving circuit; also that the per centage drop in voltage at any particular point is very small compared with the percentage line loss. In other words, for practical purposes the line has *practically* constant potential all over.

It is often advisable to install special reactances in series with the line at the receiving end, in order to obtain more total reactance than that available in the line itself, and thereby to lower the wattless current necessary for phase or potential control.

For instance, if reactive coils of 15 per cent. capacity of the load were installed, the wattless current under the condition given—the same voltage at the receiving end and the generating end—would be 54 amperes, instead of 66 amperes, as can readily be obtained by inserting $r = 10.4$; but for $x = 22.5 + 15 = 37.5$ ohms, as follows:

$$i_2 = \frac{375000}{1513} = \sqrt{\frac{(375000)^2}{1513} - 10000 - \frac{2000000 \times 10.4}{1513}}$$

$= 54$ amperes,

which shows that by the introduction of 15 per cent. reactance the condenser current is decreased 18 per cent. in this case. In general, the more reactance the lesser condenser current, or the more reactance the smaller synchronous motor is required for controlling the voltage.

The condenser current necessary to give 5 per cent. over-compounding is found by the same equation when substituting $e_0 = 9500$, $e = 10000$. This gives $i = 73$ amperes, or 23 per cent. less than when no additional reactance is used.

Before leaving this problem it is of interest to see directly the

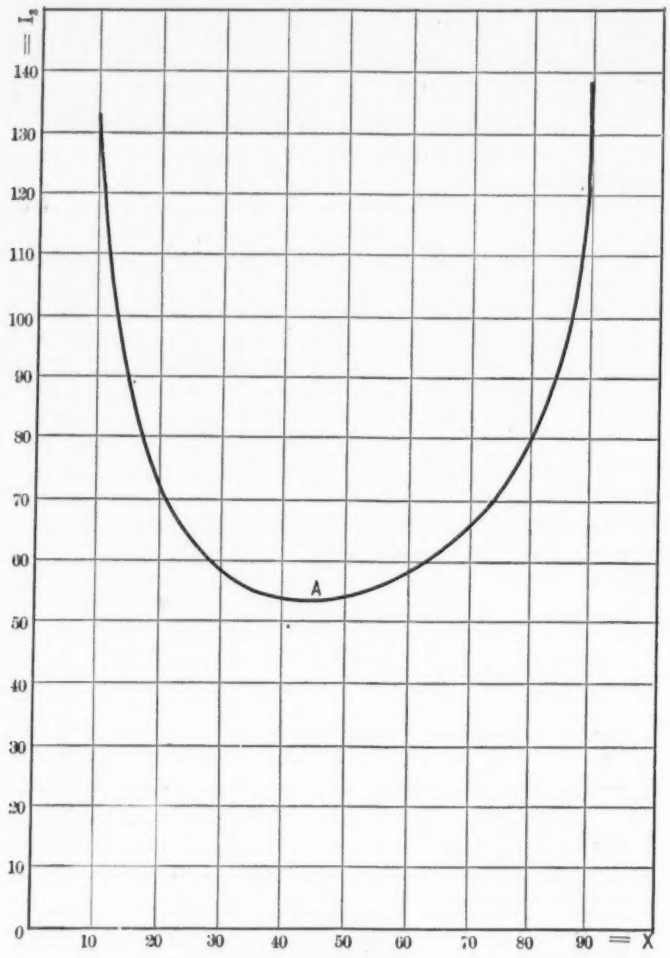


FIG. 3.—CURVE GIVING RELATION OF REACTANCE BETWEEN GENERATOR AND RECEIVING CIRCUIT, AND CONDENSER CURRENT TO GIVE SAME POTENTIAL AT GENERATOR AND RECEIVING CIRCUIT, IN A SYSTEM OF 10.4 PER CENT. RESISTANCE LOSS AT NON-INDUCTIVE LOAD.

effect of reactance on the amount of condenser current. By substituting various values of x in equation (C), the corresponding values for i_2 are found as follows:

For $x = 10$	$i = 133$
20	72
30	57.5
40	54
50	54.5
60	59
70	66
80	80

This effect of reactance is clearly shown in Fig. 3.

Briefly, there is a certain most favorable amount of reactance which corresponding to minimum current, and minimum size of synchronous motor, and which gives minimum line loss. In general, when line drop is compensated for in systems of non-inductive receiving circuits the line loss is increased. In this particular case, although with non-inductive load the loss is only 10.4 per cent., it is with various reactances as follows:

10 per cent reactance,	30 per cent.
20	16
30	14
40	12
50	14
60	14.5
70	15.5
80	18

It is frequently not advisable to insert too much reactance between the generator and synchronous motor, since the stability of the system is affected thereby.

In these cases it may seem strange that so great an amount of reactance and leading current is necessary to compensate for 10 per cent drop. The reason is that the maximum output of the line is approached. A much lesser amount would have been required if the generator was kept at 10 per cent. higher voltage at all loads; that is, if the potential at the generator had been 11000 volts at all loads, and that of the receiving end 10000 volts. Such a condition could have been obtained by under-exciting the synchronous motor at no load.

The distribution of potential along the line in such installations with reactive coils at the receiving circuit can be obtained in same manner as above, by solving equation (A) with reference to e_0, as follows:

$$e_0 = \sqrt{z^2 (i_2^2 + i^2) - 2e(i_2 x - ir) + e^2}.$$

Fig. 2 is calculated by inserting for $e = 10000$, $i = 100$, $i_2 = 54$, at generator $r = 4$, $x = 37.5$.

At 10 per cent distance from generator	$r = 9.36$,	$x = 35.3$
20	8.32	33
30	7.30	30.8
40	6.25	28.5
50	5.2	26.3
60	4.16	24
70	3.12	21.75
80	2.08	19.5
90	1.04	17.2
Converter (line side of reactive coil)	0	15
Converter (between reactive coil and collector)	0	0

From this curve it is seen that the voltage rises abruptly across the reactive coil; it is lower than the voltage at the receiving end and generating end all along the line; it gradually rises from the reactive coil up to the generating station, and rises at once across the reactance to the proper value. The drop in voltage in any point of the line is less than corresponds to the ohmic drop.

The real advantage of synchronous motor phase control is, however, first apparent in systems with inductive receiving circuits.

Referring back to equation (B) and substituting for $i_1 = i_2 - i_3$, we get:

$$i_3 = i_2 + \frac{ex}{z^2} - \sqrt{\frac{e^2 x^2}{z^4} - z^2 - \frac{2eir}{z^2} + \frac{e_0^2 - e^2}{z^2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (F)$$

In the above numerical instance assuming the power factor of the load to be 90 per cent, $i = 100$, $i_1 = \sqrt{114^2 - 100^2} = 48$. The generator voltage is obtained by solving equation (A) with reference to e_0 as follows:

$$e_0 = \sqrt{(e + ir + i_1 x)^2 + (ix - i_1 r)^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots (G)$$

substituting for $e = 10000$, $i = 100$, $i_1 = 48$,

$r = 10.4$, $x = 22.5$,

e_0 is found to be 12200 volts.

Or thus the generator voltage is 22 per cent. higher than the voltage at the receiving circuit. The energy loss in the line is $(100^2 + 48^2)$ 10.4 = 128000 watts, or 12.8 per cent. of the delivered power.

In such a system it would be well to keep the generator voltage about 10 per cent higher than the voltage of the receiving end at all loads; in other words, to keep e_0 = about 11000, and $e = 10000$ at all loads.

Furthermore, the synchronous motor has to take lagging currents at light loads and leading currents at full load.

Neglecting the small energy current necessary to run the synchronous motor light at non-inductive excitation, and assuming that the nature of the load remains the same at all loads—that is, its power factor remains the same, we have $i_2 = .481$. Assuming further $e_0 = 11200$ volts, $e = 10{,}000$ volts, and substituting these values in equation (G) and solving with reference to i, it is found that $i_3 = 52$ amperes, or, at 52 per cent. of rated load, no phase control is exerted.

At no load the synchronous motor should take 52 amperes lagging current, and at full load 52 amperes leading current. In other words, the capacity of the synchronous motor is just about 50 per cent. of the load.

The amount of current taken by the motor at all loads is shown in Fig. 4. As will be seen, the synchronous motor should run non-inductively at 54 per cent. of full load of the system.

Without the use of a compensator, the full load line current is 111 amperes, therefore the loss is $111^2 \times 10.4 = 128000$ watts, or 12.8 per cent. of the delivered power. With the synchronous motor the line current is 100 amperes, and the loss therefore only 104000 watts, or 10.4 per cent. The poorer the power factor of the load, the more advantageous it is to use this method of potential control.

In conclusion it may be brought out once more that although a non-inductive receiving circuit has been considered chiefly in the

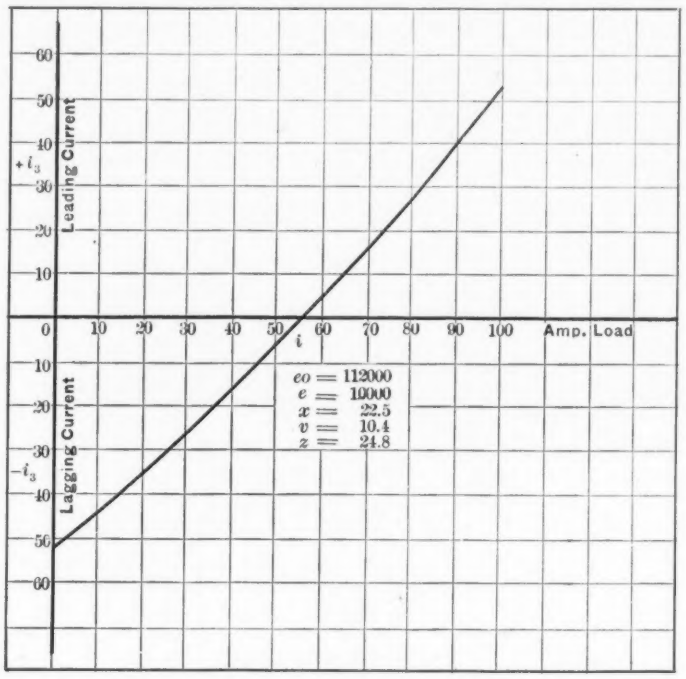


FIG. 4.—CURVE GIVING RELATION OF LEADING AND LAGGING CURRENT TAKEN BY SYNCHRONOUS MOTOR AS FUNCTION OF LOAD OF THE RECEIVING SYSTEM. GENERATOR VOLTAGE KEPT CONSTANT AT 11200 VOLTS, VOLTAGE AT RECEIVING END OF LINE 10000 VOLTS AT ALL LOADS.

present instance, this method of compensation of drop is not well suitable except in cases where the load is more or less inductive, or when it is desired to have the voltage constant and the same all along a line.

It is hardly desirable to try to maintain the same generator voltage as the voltage at the receiving end, or to get a higher voltage at the receiving end than at the generator, unless there is no objection to large reactances and comparatively large wattless currents. It is, however, perfectly feasible to maintain the generators at a somewhat higher voltage than that at the receiving end at all loads; in other words, to lower the voltage by means of under-exciting the synchronous motors, which causes them to take lagging current at no load, and to run them under non-inductive condition at part of the load, and with leading currents at full load. Under these conditions, the amount of reactance, leading current and boosting the voltage can be comparatively closely approximated as follows:

With 10 per cent. reactance and full load leading current, 10 per cent. boosting of voltage is obtained. With 20 per cent. reactance and full leading current, 20 per cent. boosting is obtained. With 10 per cent reactance and one-half full load leading current, 5 per cent. boosting is obtained. With 20 per cent. reactance and one-half full load leading current, 10 per cent boosting is obtained, etc.

This rule holds comparatively good unless the maximum output of the line is approached, as is the case in the examples assumed.

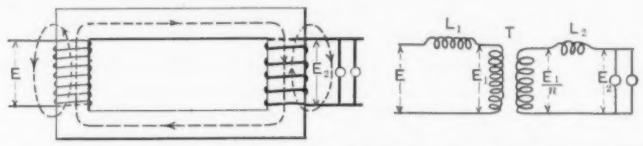
The chief advantage of the synchronous motor used as compensator is, however, to be found in systems of lagging currents, such as induction motor installations, where the drop in the line and the current in the line are larger than at non-inductive load. In such case not only is the efficiency of the system raised, but the line loss is lessened; whereas, with non-inductive load, the line loss is increased by the use of synchronous motors or potential control.

A Graphical Treatment of the Effect of Magnetic Leakage on Transformer Regulation.

BY F. G. BAUM.

THE following method of determining the regulation of a transformer perhaps presents nothing new. The attempt has merely been made to put the matter in such form as to be available to practical men. The subject graphically treated will be clearer—even to mathematicians—than if put in the form of equations.

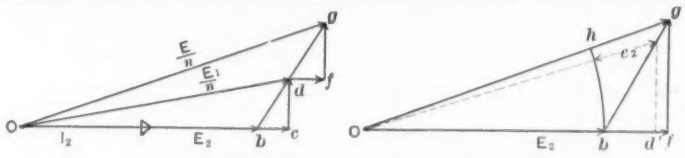
In Fig. 1 we have, diagrammatically represented, a transformer. Electric pressure is set up in the secondary by a changing magnetic flux which threads the primary and secondary coils. Besides this magnetic flux which threads both circuits, there are lines of force, due to magnetic leakage, which thread only the primary turns, and other lines of force which thread only the secondary turns. Now, consider the effect of the leakage lines of force—that is, only those lines of force which thread one coil and do not thread the other—on the pressure relations in the primary and secondary coils.



FIGS. 1 AND 2.—TRANSFORMER WITH MAGNETIC LEAKAGE, FIG. 2 ELECTRICALLY EQUIVALENT TO FIG. 1.

The lines of force which thread only the primary turns will, clearly, set up an e. m. f. of self-induction at right angles to the primary current; that is, these lines of force act like an inductance in series between the dynamo and the transformer. The leakage lines in the secondary circuit similarly act as an inductive e. m. f. in the secondary circuit between the terminals of the transformer and the load. What amounts to the same thing, we may consider a certain number of the primary turns as taken out of the transformer and put in the line between the dynamo and the transformer. Similarly, a certain number of the secondary turns may be considered as connected between the transformer terminals and the load. Represent the inductances corresponding to these turns respectively by L_1 and L_2, we have a condition represented diagrammatically in Fig. 2.

A little consideration will make it evident that, in a transformer in which the primary and secondary coils are similarly disposed with respect to the magnetic circuit, the primary turns in series in the primary circuit are equal to the ratio of turns, n, on the transformer, times the turns in series in the secondary circuit. That is, the leakage lines are practically equal for the two coils, but the primary leakage lines cut n times the number of turns cut by the secondary



FIGS. 3 AND 4.—PRESSURE DIAGRAMS OF FIG. 2.

leakage lines. This leaves a transformer, T, with the same ratio of transformation as the ratio of turns, n, in Fig. 1, but in which there is no magnetic leakage between primary and secondary turns. With this arrangement it is an easy matter to determine the regulation of the transformer for any load and for any power factor.

We will assume for the present that the inductances L_1 and L_2 are known, and point out later how the regulation of the transformer is determined in practice without loading the transformer. The transformer is assumed to carry such a load that the primary and secondary currents are practically in opposition. This assumption will be true for any closed-circuit transformer carrying 25 per cent. load or over. Let us take, first, the case of a non-inductive load.

Lay off, as in Fig. 3, $ob = E_2$ horizontally, in the same direction as I_2, the secondary current. From b lay off the value $bc = I_2 r_2$, the resistance drop in the secondary; and at right angles to bc lay off $L_2\, w\, I_2 = cd$. This gives $od = \frac{E_1}{n}$ as the e. m. f. that would have to be applied to pq, Fig. 2, to produce the pressure E_2 at the terminals of the load. We must now transfer to the primary circuit, and instead of multiplying all the sides of the triangle ocd by the ratio of turns, we may reduce all the pressures in the primary circuit by the ratio of transformation and lay them off on Fig. 3.

Lay off from d the value $df = \frac{I_1 r_1}{n}$ parallel to dc, and from d the value $fg = \frac{L_1 w I_1}{n}$ at right angles to df. This gives $of = \frac{E}{n}$ as the primary pressure, reduced by the ratio of transformation, that must be applied to the primary of the transformer to produce the secondary pressure E_2 at the terminals of the load. The values of the resistance and reactive drops in the transformer have been exaggerated to make the figure clear. In practice, however, by taking a large scale of pressures, very good results may be obtained by the graphical method.

With the assumptions that have been made, cd and fg, of Fig. 3, have practically the same value, and since bc and df are small in comparison with these bdg may be taken as a straight line. We may, therefore, replace the two triangles, bcd and dfg, by a single triangle, bfg, Fig. 4, having as base a length bf proportional to the load on the transformer, since

$$bf = bc + df = I_2 r_2 + \frac{I_1 r_1}{n} = I_2 r_2 + \frac{I_2 r_1}{n^2} = I_2 \left(r_2 + \frac{r_1}{n^2}\right).$$

If, now, with $E_2 = \rho b$ as radius, we draw the arc of a circle oh, we cut off between the straight line bf and the arc bh a length e_2 which gives the drop in secondary pressure for the load corresponding to the length bd[1]. That is, the regulation of the transformer is shown in the figure. Algebraically expressed, we have, from the figure:

$$\frac{E}{n} = \sqrt{(E_2 + bf)^2 + (fg)^2}, \text{ giving}$$

$$E_2 = \sqrt{\left(\frac{E}{n}\right) - (fg)^2} - bf; \text{ in which}$$

$$bf = I_2 \left(r_2 + \frac{r_1}{n^2}\right) \text{ and}$$

$$fg = I_2 \left(L_2 w + \frac{L_1 w}{n^2}\right)$$

In practice the two triangles bcd and dfg, in Fig. 3, cannot be obtained. The triangle bfg, Fig. 4, which answers all practical purwinding and determining the pressure $e = bf$, Fig. 4, necessary to

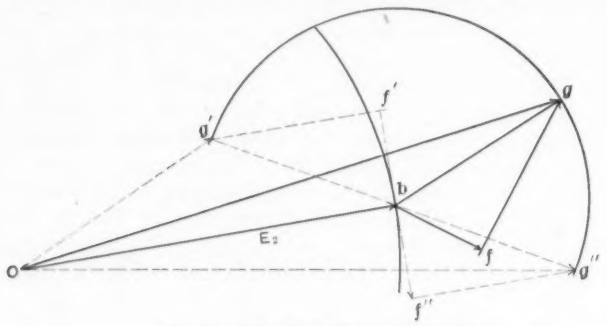


FIG. 5.—TRANSFORMER DIAGRAMS.

send full-load current through the primary, and calculating bf by the formula

$$bf = I_2 \left(r_2 + \frac{r_1}{n^2}\right).$$

If the secondary is short-circuited, bf is calculated by the formula

$$bf = I_1 r_1 + I_2 r_2 n = I_1 (r_1 + r_2 n^2).$$

If the load is non-inductive, the application of the method, after determining the triangle bfg, is equally simple. The line bf represents equally as well, is obtained by short-circuiting the primary senting the resistance drop must be drawn from b in the direction, with respect to E_2 corresponding to the power factor of the load, and fg drawn at right angles to bf. In Fig. 5, is shown in heavy lines the position of the triangle for a power factor of 0.8.

The locus of the point f for the same current, but variable power factor, is a circle with bg as radius and b as centre. The limiting positions of the triangle are bf' g' and bf'' g'', corresponding to 90° leading and lagging current, respectively. As seen from the last figure, for lagging currents the secondary pressure drops, and for leading current the secondary pressure rises with increasing load; og' multiplied by the ratio of transformation will give the dynamo pressure for a secondary pressure, E_2, applied to a load having a 90° leading current; and og'' the pressure for a 90° lagging current. This rise in pressure for a leading current is especially noticeable on long-distance transmission lines. The charging current of the line passes through the step-up transformers where a rise in pressure takes place, interfering materially with the regulation of the system on light load.

To obtain good regulation for all power factors, fg must be small. In the best transformers, however, fg is several times greater than bf. The general equation for the secondary pressure for any load and any power factor may be at once written out by inspection of Fig. 5.

Henry Centennial Celebration.

At the Henry Centennial celebration at Albany, Dec. 16, which was conducted under the auspices of the Albany Institute and the Albany Historical and Art Society, Mr. James F. McElroy read a paper entitled "Joseph Henry's Contributions to Science."

Mr. McElroy stated that the first notable work of Henry in electrical science was an investigation of the laws governing the development of magnetism in soft iron by means of the electric current. In 1825 Barlow, after a careful investigation, reported that he found the magnetic effects through a wire 200 feet long diminished to such an extent as to convince him that the electromagnetic telegraph was impossible. Henry, however, showed that by properly proportioning the magnet windings to the circuits upon which they were to be employed, magnets could be constructed applicable to long-distance work. The magnets for the latter class of work he called "intensity" magnets, the windings of which contained the more turns the greater the exterior resistance. Where the exterior resistance was small, the number of turns was also small, magnets of this kind being named "quantity" magnets. Henry thus established the principle that the power of a magnet depends upon the number of ampere turns. The direct effect of his investigations was to establish the possibility of the electromagnetic telegraph.

Not satisfied with thus showing indirectly that the electromagnetic telegraph was possible, he at once proceeded to a practical demonstration. A wire over a mile in length was stretched around the walls of a room in the Albany Institute, having in circuit a battery and an arrangement whereby a magnet when excited caused a bar to strike a bell. This bar, 10 inches long and permanently magnetized, was pivoted in the centre in such a position that a slight motion on the pivot caused one end of the bar to strike the bell. The other end of the bar was supported between the two arms of a horseshoe magnet. When the magnet was excited by the current, one end of the bar was attracted by one end of the magnet and repelled by the other, the motion thus imparted causing the opposite end to strike the bell. To return the steel bar to its original position, a commutating switch was used which changed the polarity of the magnet and caused the bar to move in the opposite direction.

His next step was to devise and apply the relay principle. An "intensity" magnet at the end of a long line opened and closed the circuit of a local battery in which was placed a "quantity magnet." The signals were thus made strong and distinctly audible.

In January, 1831, descriptions of his experiments on the electromagnetic telegraph were published; while his testimony, together with that of a large number of his students at Princeton, showed clearly that he introduced a relay circuit in his experiments before the senior class from 1833 to 1837, he having resigned from the Albany Academy in 1832 to accept a position at Princeton. After Prof. Henry moved to Princeton in the latter year, he erected a line on the campus which was mounted on poles of insulators. For a telegraph line erected in 1835 he used but a single wire and a ground return. One end of the wire terminated in a metal plate buried in the college ground near Prof. Henry's house, and the other was earthed near the Philosophical Hall.

In July, 1831, Henry described in Silliman's *Journal of Science* a form of oscillating electric motor, consisting of two upright magnets which, he stated, may be either permanent magnets or electromagnets. The repulsion of like poles and the attraction of unlike poles caused a rocking motion of the electromagnet which lifted the contact from the mercury cups on one end and closed magnets on the

opposite side, thus causing a reversal of current and consequently of motion.

In a paper read before the American Philosophical Society, June 17, 1842, Prof. Henry gave as the result of experiments the deduction that the discharge from a condenser is of an oscillatory character. He states that the phenomena observed required the existence of a principal discharge in one direction and then several reflex discharges backward and forward, each more feeble than the preceding, until equilibrium is restored. "All the facts are shown to be in accordance with this hypothesis, and a ready explanation is afforded by it of a number of phenomena which are to be found in the older works on electricity, but which have until this time remained unexplained." He also maintained that the lightning flash between two clouds consist of a series of discharges moving to and fro "like a shuttle in quick succession."

In a paper presented to the British Association in 1837, Prof. Henry described experiments showing that high-frequency discharges tend to give off sparks to all bodies in the vicinity however intimately the conductor may be connected with the earth. He also discovered that such discharges travel principally on the surface of the conductor and not through the solid metal, and advised the use of lightning conductors having large surface rather than large cross-section.

JOSEPH HENRY.

Concerning the discovery of electromagnetic induction, Mr. McElroy states that Henry was the first to make the discovery, though Faraday was the first to publish it. It appears, he says, that Henry's attention was called to a brief notice of Faraday's discovery in the *Annals of Philosophy* for April, 1832, and at once prepared an account of his own experiments, which he published in Silliman's *Journal of Science* for July, 1832. The daughter of Prof. Henry says he was filled with disappointment that he should be superseded by Faraday as the discoverer of electromagnetic induction, all on account of the fact that he was waiting until he completed a large apparatus with which he proposed to perform a second set of experiments. Before the second set of experiments was completed, Faraday published his results. Faraday's discovery dates from the last of September, 1831, while, it is stated, Henry completed his experiments between Sept. 23 and Nov. 6, an account of which was read before the Royal Institution Nov. 23, 1831, and appeared in print in January, 1832. No date is given in the paper as to Henry's discovery, but it is asserted that after having made it by means of a small magnet, he proceeded to build a large apparatus to continue his experiments, and that work on this apparatus was interrupted by the demand to vacate the room used, on account of the public exercises to be held in the school Aug. 3, 1831.

It was while Prof. Henry was engaged in his experiments on electromagnetic telegraphy that he discovered the phenomena of inductance. He first observed that a battery short-circuited by means of a short wire exhibits on breaking the circuit but a small tendency to spark. When, however, the circuit is closed through a wire of considerable length, a vivid spark is produced whenever the circuit is broken. He developed experimentally the phenomena of inductance and showed how shocks were produced and the effects increased with the length of wire; that the effect is greater when the wire is coiled than when straight; and that the greatest effects are produced when a wire is coiled and placed around a soft iron core.

Another line of Henry's work was with reference to mutual induction. A series of parallel wires was arranged at different distances from the prime conductor and an induced current was generated in each of the parallel conductors. He also experimented with electromagnetic induction at a distance. Two wires were separated a distance of 30 feet and two intervening floors, and the induced current used to magnetize steel needles. Henry also carefully studied the inductive action between coils of different numbers of turns, and showed how thereby a voltage may be stepped up and stepped down, as in the induction coil and modern transformer.

In an address during the celebration, Mr. Alexander Selkirk gave an account of the ancestry and early life of Henry. Joseph Henry was born Dec. 17, 1799, near Albany, N. Y. James Henry, his grandfather, emigrated to America in 1775 from Kirk Cudbright, Scotland, and settled in the town of Galway, Saratoga County. His son, William, moved to a farm located below the City of Albany, near a place known as Cherry Hill. There he married Ann, daughter of James Alexander, whose grandfather arrived in America the same time as James Henry. Joseph was the younger son of William, and lived with his parents until he became old enough to go to school. He was then sent to his grandfather at Galway, where he attended school from his sixth until his tenth or eleventh year. When eleven years of age he returned home and worked on the farm until after his fourteenth birthday, going to school in Albany during the later fall and winter and early spring months.

At the age of fourteen he left home and obtained employment as an apprentice to a silversmith, but in his sixteenth year left to enter the Albany Academy. When eighteen years of age he obtained employment as a school teacher at Selkirk, below Albany, and with money saved from his salary of $15 per month, re-entered the Albany Academy and continued his studies. Later he was advanced to the postion of assistant in the academy, and for his services received compensation which, with the money earned from giving private lessons and service as tutor in a family and as surveyor in vacation time, enabled him to go through the academic course, devoting his leisure hours to more advanced studies in mathematics, chemistry and other sciences.

The Telephone and Divorce.

Dagonet writes in the London Referee: "The telephone, by the bye, is about to figure in the divorce court. The story which will be told is a most remarkable one. A husband had gone out of town 'on business' and given his wife a big hotel at Liverpool as the address at which to write to him. The day after his departure the wife went to see her brother, a merchant in the city, and while in the office the brother was rung up from Manchester.

" 'Oh,' said the wife, 'how wonderful! Can you hear what they say?'

"Assured that one could hear perfectly, the affectionate wife, thinking to give her husband a pleasant surprise, asked to be put on to the hotel in Liverpool at which he was staying. The connection was made. Now, her husband had taken a private sitting-room, which had a private telephone on the writing table. The manager of the hotel, ascertaining that the guest was in his room, instantly switched London through to his private apartment.

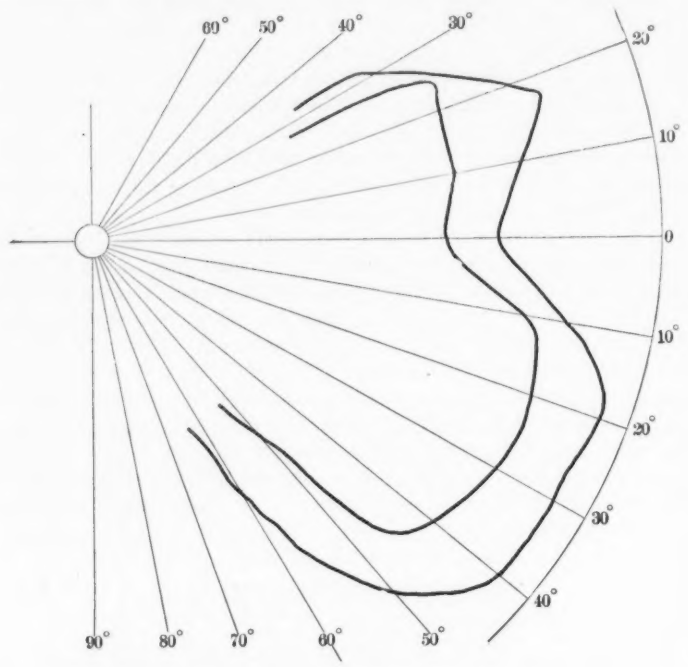
"The husband went to the telephone and said: 'Hulloa! What is it?' and at the same time a lady in the room exclaimed: 'What! Do you say London is speaking to you? Oh, do let me listen!' The astonished wife at the other end started back with an exclamation of horror. She knew the voice of the lady.

"The husband listened in vain for London's message. It was never given. After waiting some time he rung off, concluding that it was a mistake. But late that night the mistake was explained to him. His wife arrived at the Liverpool hotel. The rest of the story will be told before Sir Francis Jeune early in November."

Relative Candle-Powers of Alternating and Direct-Current Enclosed Arc Lamps.

In a paper read before the December meeting of the Chicago Electrical Association by Mr. E. P. Warner, on "Alternating Current Arc Lighting," the subject of the relative candle-power from direct and alternating current enclosed arcs was discussed at some length. Accompanying the paper was a diagram of curves plotted from photometric measurements taken of an alternating and a direct current lamp, both of the enclosed type. The two lamps were operated under the same voltage, with the same kind of globes and with all the other conditions alike for the two. Of these curves, which are shown in the accompanying figure, the inner one is that plotted from the measurements of the alternating current lamp and the outer one from those of the direct current lamp. It will be noted that while the direct current lamp exceeds the alternating current in light capacity by an average of about 12 per cent., there is a remarkable similarity with respect to distribution. The tests were made purely with a view to determining the relative intensity, and the curves do not show actual candle-power.

Mr. Warner referred to the difficulty in making photometric measurement of arc lamps, especially of the enclosed arc. The alternating arc continually shifts from place to place, which results in enormous changes in the intensity of the light. When the arc is



CURVES OF PHOTOMETRIC MEASUREMENTS.

upon one side of the carbons, the light emitted from the opposite side is comparatively weak, and for about 5 degs. above and below the horizontal plane it is very strongly violet, while upon the side where the arc is located the light is quite intense and white in color. It becomes necessary, therefore, in making the photometric tests of this arc to secure a large number of measurements and take the mean in order to arrive at anything like a safe average.

This peculiarity of having a violet band upon one side and a bright light upon the other seems to be more a characteristic of the alternating than of the direct current enclosed arc lamp. It is true that the arc of the direct current lamp shifts about very considerably, and that when it is upon one side there is a considerable shadow from the carbons upon the other side and a marked diminution of light; and the same precautions had to be taken in measurements of light intensity with this lamp as with the alternating. It was found, however, that a safe average could be obtained with a considerable smaller number of measurements than with the alternating.

Mr. Warner said that in the application of reflectors on the alternating lamps the results he had obtained are not particularly encouraging. While there is undoubtedly some advantage to be gained by their use, there are numerous difficulties in the way of using effective reflectors, and such reflectors as are found suitable for use and practical have not been found very effective. In the measurements of relative light intensity given in the diagram, the alternating lamp was supplied with a metal reflector white enameled on the under side, while the direct current lamp had no reflector. It will be noted that notwithstanding this fact, the light intensity in the upper portion of the curve from the direct curent lamp is considerably greater than that from the alternating.

In order to correct the violet rays in the alternating lamp and make it acceptable for commercial lighting, Mr. Warner has used what is known as an alabaster globe. This globe is composed of two layers or thicknesses of glass, one of which is clear or slightly tinted with uranium, and the other opalescent. The combination of these two acts upon the violet rays almost the same as an aqueous solution of quinine sulphate, and transforms the violet into white light. This result is not effected, however, without a material loss in the intensity of the light, but it has been found in practice to be a necessary sacrifice, as in almost all instances a proper color of light is demanded irrespective of the power.

Recent claims relating to alternating arc lamps in series arc lighting were referred to as somewhat overenthusiastic in the matter of light distribution and the fogging or clouding of the globe by deposits from the arc. He considers that the deposit upon the interior of the enclosing globe is somewhat greater from the alternating arc than from the direct current, and begins to form considerably sooner after the light is started. This he believes to be due to the fact that cored carbons are used in the alternating lamps, as when an alternating lamp is operated with solid carbons there seems to be no more deposit than if the current were direct. However, the advantages gained by the use of cored carbons in the alternating lamp are such as to more than offset the objection.

Gas and Electric Combination in New York City.

Reference was made in this paper last week to the reports current as to an absorption by the Consolidated Gas Company of the electrical interests of the New York Gas & Electric Light, Heat & Power Company, the transfer taking the shape, it would seem, of the control of the majority interest in the $36,000,000 of stock. It is also stated that the entire stock issue will be "exchanged for a security which is backed by the Consolidated Gas Company." It is further stated that the Consolidated Company are in control of the United Electric Light & Power Company of New York. This being so, the electrical central station interests of New York City are united under the Rockefeller gas régime.

The amount of capital represented by this huge deal reaches well towards $100,000,000. The New York Gas & Electric Light, Heat & Power Company has $36,000,000 common stock and $36,000,000 bonds, the details of the latter having been given in our last issue, at which time the company listed upon the Stock Exchange $11,500,000 of its first mortgage bonds and $20,191,000 of its purchase money mortgage bonds. The purchase money bonds are each for $1000, maturing February 1, 1948, bearing interest at 4 per cent. in gold coin. Of the proceeds of this issue $20,240,000 are to be applied in acquiring the shares of the capital stock of the Edison Electric Illuminating Company of New York. The total capital stock of this company is $9,200,000 and the purchase price is 220 per cent. of the par value of said stock. About 89,000 out of the 92,000 shares of the capital stock of the Edison Company have been acquired at this date. The first mortgage bonds bear interest at the rate of 5 per cent. in gold coin, and mature December 1, 1948. Proceeds of the issue were applied as follows: $7,500,000 on account of the purchase price of the constituent companies and $4,000,000 to create a cash guarantee fund, which may only be invested in extensions or betterments. As to the United Electric Light & Power Company—which may be said to represent the Westinghouse interests, as the New York stood for those of the General Electric—its common stock is $4,000,000; cumulative preferred stock, $2,000,000; first mortgage 5s, $5,000,000; United States Illuminating Company, first mortgage 5s, due 1905, $400,000; Brush Electric Illuminating, first mortgage 5s, $275,000. Outside of all the above would appear to be the old bonds formerly issued by the New York Edison Company before its absorption by the Whitney interests.

Some of our readers may not be aware that a fierce gas war has been waging in New York for some time between the Consolidated, Standard and New Amsterdam interests, as the result of which the Consolidated has brought its present price for gas down to 65 cents. By its recent acquisitions in the electrical field it is in a dominating position as to all classes of illumination that may enable it soon to bring the gas war to an end. To what extent the

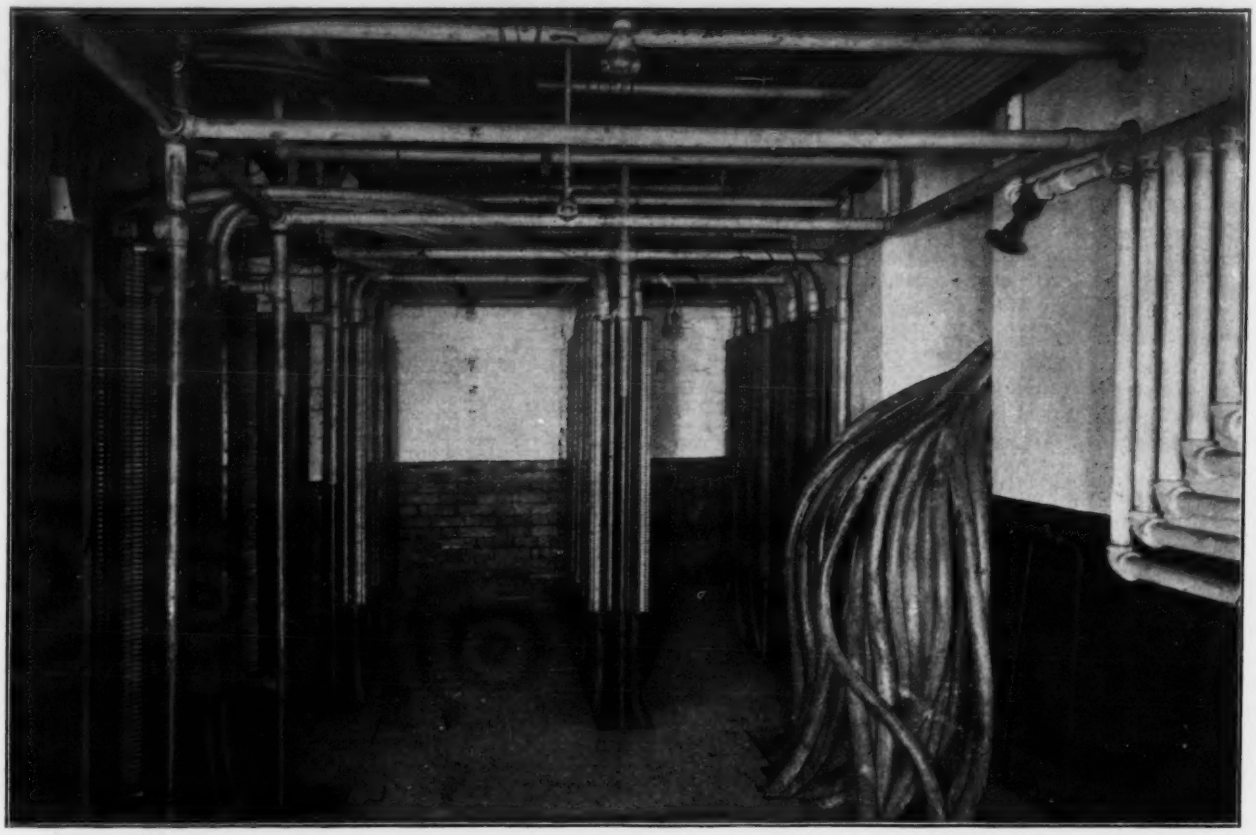


FIG. 16 IN THE TERMINAL ROOM, LOOKING WEST, SHOWING TERMINAL HEADS.

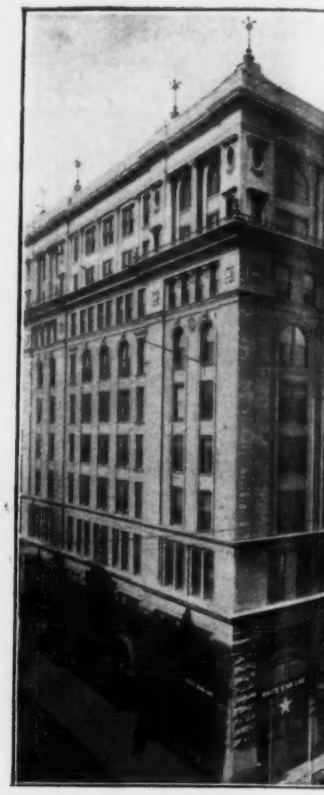


FIG. 17.—CENTURY BUILDING, KIN

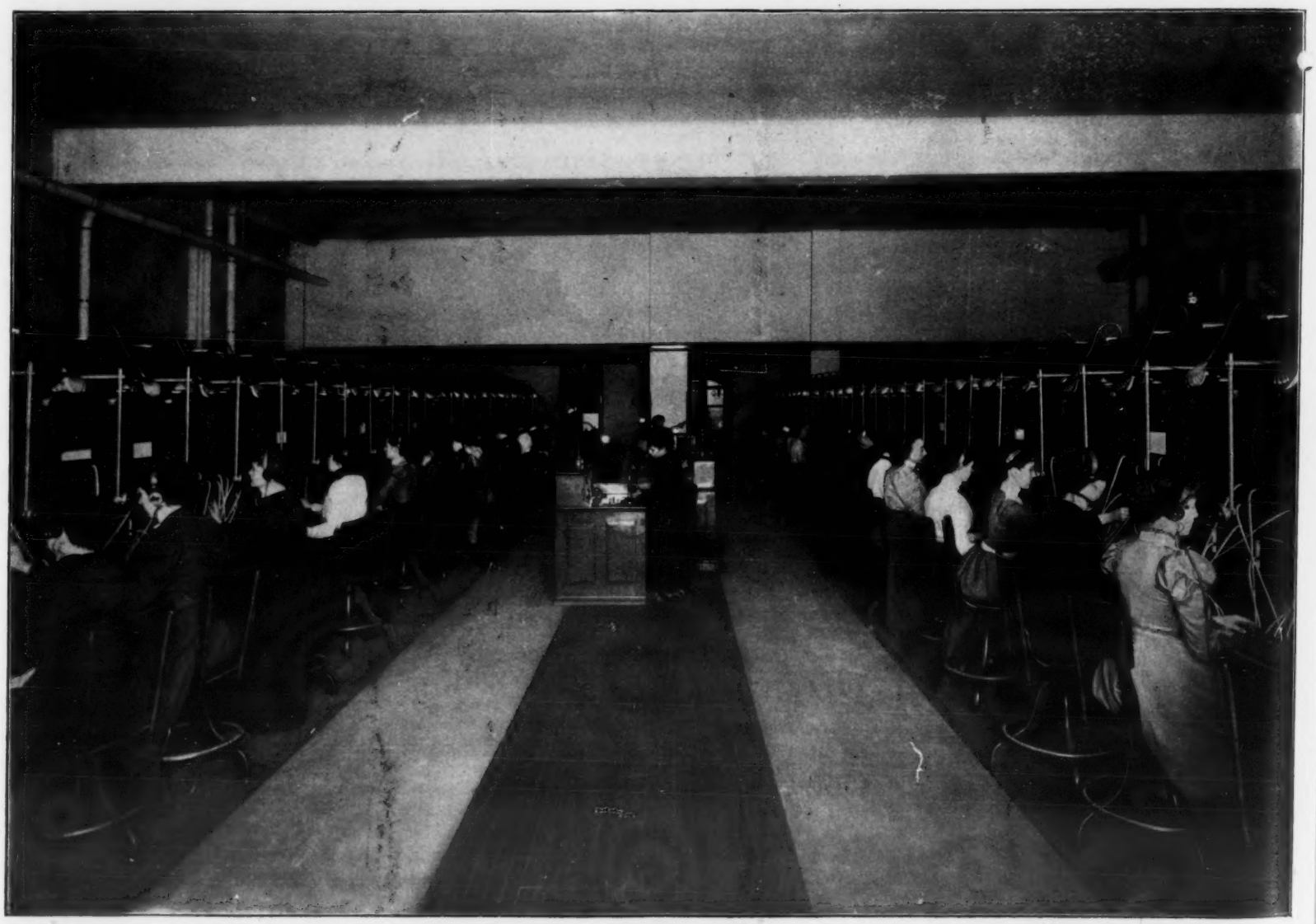
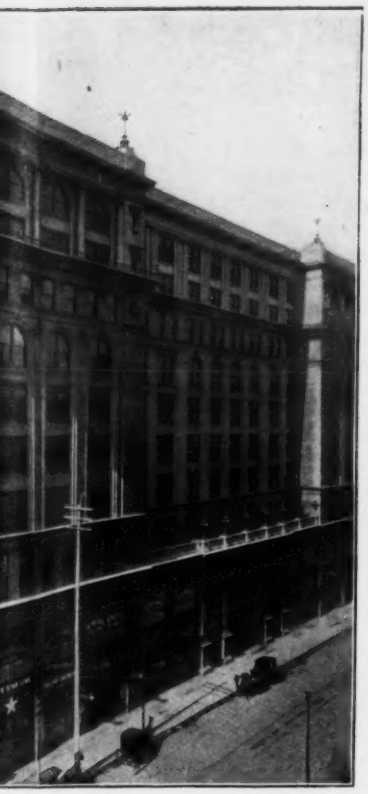
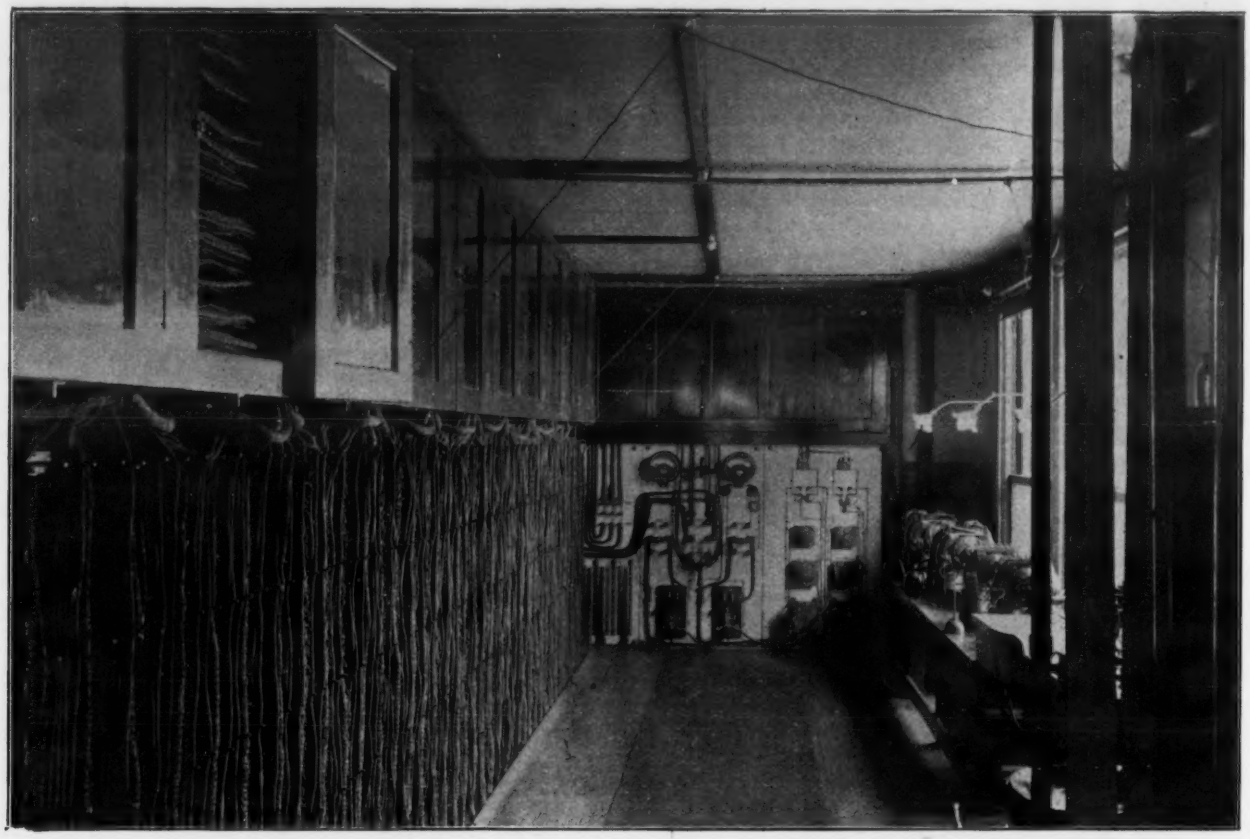


FIG. 19.—THE OPERATING ROOM, LOOKING DOWN CENTRE AISLE, SHOWING B AND C DIVISIONS.





, Kinloch Telephone Co., St. Louis. Fig. 18.— Distributing Room, Showing Racks, Motor Generators, Ringing Generators and Power Switchboard.

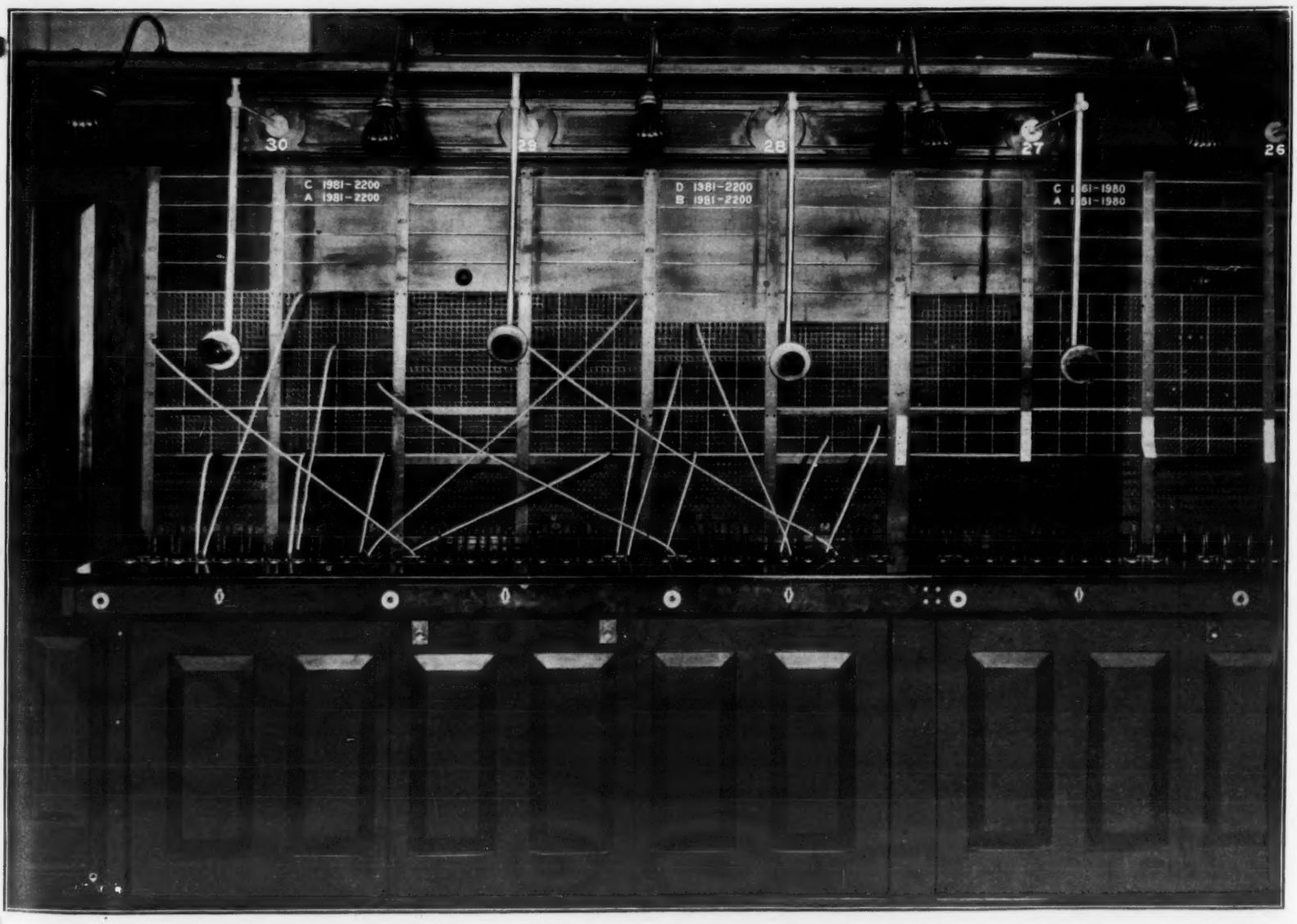


Fig. 20.—A Section of the Switchboard, Showing a Few Connections Up.

ELEPHONE EXCHANGE, ST. LOUIS, MO.

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big deal is an absorption rather than a consolidation does not appear on the surface, but it is stated that the relations of Messrs. W. C. Whitney and A. N. Brady and their friends, on the one hand, with Mr. J. D. Rockefeller and his associates on the other, are quite friendly, and that in some respects the Whitney interests will benefit materially, their outlay on the New York electric lighting acquisition having been in reality insignificant up to date from the time they acquired the Edison properties.

One rumor that has sprung up and has been repeated with persistence is that such a large concern with its affiliations might well engage in its own manufacturing to keep down costs of apparatus. While the General Electric and Westinghouse Electric Manufacturing Companies are the "parents" of the united New York systems, the offspring in this city alone is already twice as big as they are combined, and, therefore, it is urged, it is not likely to take dictation as to prices or methods very kindly. The Whitney interests own the Siemens-Halske Electric Company, and are naturally in close relationship with the Pennslvania Iron Work Company, an Elkins institution, with shops located in Philadelphia, and which has built steam plants for some of the large street railway systems. There is no confirmation, however, of any of these reports.

Financing Bell Telephone.

It is stated by financial authorities in Boston that the American Bell Telephone & Telegraph Company has sold $10,000,000 thirty-year 4 per cent. collateral trust bonds, under a new indenture which permits the issue of $100,000,000 bonds. Of the $10,000,000 bonds sold $3,000,000 were issued to a syndicate of Boston bankers, and the others will be issued in instalments throughout the year 1900 as funds are required for extensions. The collateral is composed of 15,401 shares of Bell Telephone Company, of Canada, 97,899 shares New England Telephone & Telegraph Company, 36,004 shares Western Electric Company, $1,000,000 Central Union Telephone Company first mortgage bonds and $200,000 Iowa Telephone Company first mortgage bonds, the above collateral having a par value of $15,000,000 with a market value of $20,000,000. A proportion of the above collateral is set aside to protect the $5,049,000 ten-year debenture bonds of the American Bell Telephone Company, and the remainder is to cover the issue of American Telephone & Telegraph Company bonds up to $5,000,000. Additional collateral will be put up as additional bonds are issued. The indenture under which the above bonds are issued is not limited as to amount, except as regulated by the long-distance company's capital under New York laws. These laws permit of an issue of mortgage bonds to the same amount as the capital stock issued, and also in addition the issue of collateral trust bonds to an amount equal to the share capital issued. At first the American Telephone & Telegraph Company will have $50,000,000 of stock, or double the amount of Bell Telephone stock, which will permit the issue of $100,000,000 bonds. The bond indenture bears date of July 1, 1899, and is between the American Telephone & Telegraph Company and the Old Colony Trust Company, trustee. The indenture gives the company the right to issue bonds bearing a lower rate of interest than 4 per cent. It also states that the indenture shall not prevent a consolidation or merger of the companies whose shares have been, or shall be delivered to the trustee.

A special despatch from Boston says in regard to the above: Last Friday afternoon the American Telephone & Telegraph Company completed arrangements with Messrs. Kidder, Peabody & Company for financing the needs of the company for the year 1900, to the extent of $10,000,000. The arrangement was partly firm and partly on options. A syndicate for the sale of the securities was then formed, and this syndicate has sold privately $2,000,000 of notes and $3,000,000 of bonds. The price of the bonds is understood to have been slightly under par; $1,000,000 of the notes were at private sale, and $1,000,000 on competitive bids to F. S. Moseley & Co., on the basis of 5.325 per cent. Only $2,000,000 more of the bonds will probably be sold at present, at about par.

CURRENT NEWS AND NOTES.

AUTOMOBILES IN HONOLULU.—A Honolulu (H. I.) company has ordered twenty-five electric automobiles, which will be operated on the streets of Honolulu in competition with hacks.

ELECTRICITY AS AN ANAESTHETIC.—The newspapers have been devoting some space to an alleged discovery by a Yale professor of the use of electricity as an anæsthetic. High-frequency currents are used and the effect produced is called "Electrical anæsthesia." Such a current is sent longitudinally along a nerve and deadens sensibility. It is probable that the newspaper accounts are mistaken in reporting that the discovery is claimed as a new one, for electrical anæsthesia has been made the subject of study by Dubois Reymond, Apostoli and others.

COMPOSITE INCANDESCENT LAMP LEADING-IN WIRES.—A patent was granted Jan. 2 to Friedrich O. Schott, of Jena, Germany, on a process for coating oxidizable metal wire with a gas-tight coating. The oxidizable wire is introduced within a glass tube slightly larger in diameter than the wire; the air contained in the tube is then displaced by continuously blowing through it, by means of a pipe, an inert gas, such as carbonic acid gas, coal gas, etc.; the tube is then melted upon the wire core with the blowpipe.

ENCLOSED FUSE.—A patent was issued Jan. 2 to L. W. Downes on an improvement in the construction of enclosed fuses. Instead of, as is usual, employing a single fuse wire, a plurality of fuse wires are connected in parallel between suitable terminals and enclosed in a sheath containing a filling of porous or similar material about the wires, thus providing a multitude of interstices for disintegrating or breaking up and conducting away the metallic vapor or gas evolved by the fusing of the wires. In the central longitudinal portion of the enclosing sheath is an air space through which the fusible wires pass.

STORAGE BATTERY PLATE.—A patent was issued Jan. 2 to Frank R. Wiley on a type of storage battery plate having for its object to provide an element which shall be as light and compact as possible and at the same time be adapted to contain a maximum amount of compressed active material. Each plate is composed of separate front and rear grids, the intersection of the bars of one grid being opposite the apertures of the other grid. By means of cross bars or projections cast on the inner parts of the grids, the bars of one grid is connected at points between its intersection with transversely arranged bars of the other grid intermediate of their intersections.

WATTMETER ATTACHMENT.—A patent was issued Jan. 2 to Caryl D. Haskins on a wattmeter attachment. It often happens in the operation of isolated installations that the maximum load becomes greater than the generating plant can carry. In such cases it is customary to call on the central station service for the excess, installing a wattmeter for its measurement. This arrangement, however, permits the ready cancellation of the meter charge by running the isolated plant at a little higher voltage during the times of minimum or no load, so as to return current to the street mains, the effect being to borrow energy at the time of the central station maximum demand, and to return it at the time of minimum demand. The attachment to which the patent relates is an electromagnet in series with the wattmeter fields, the polarized armature of which breaks the wattmeter circuit, should the direction of current through it be reversed.

NORTHWESTERN ELECTRICAL ASSOCIATION.—Secretary Mercein has just issued this trumpet call: Hotel Pfister, Milwaukee, Wednesday morning, Jan. 17. A large and interesting meeting assured. One and one-third round trip rate on the certificate plan granted by the Western and Central Passenger Associations for the occasion. Write to James Wolff, chairman, 320 Dearborn Street, Chicago, for special train and car arrangements, and to manager Hotel Pfister for rooms, exhibit space, wiring and current. Secure your hotel accommodations in advance. Mail to me now all questions you want answered at the convention. The best brains and experience of the Northwest will be there to give you information. The managers of all the McMillin electrical plants will attend our convention after their annual meeting the day previous. Theatre parties, etc., Wednesday night. Our annual banquet, Thursday night. Come and bring your friends. All electrical men welcome. Following is a list of the papers to be read at the meeting: "Modern Development in Alternating-Current Series Arc Lamps," by R Fleming, Lynn, Mass.; "Alternating-Current Phenomena," by Prof. Jackson, Wisconsin University; "Combination of Electric Lighting and Hot

Water Heating Plants," by W. H. Schott, Chicago, Ill.; "Central Station Economics," by H. W. Frund, Vincennes, Ind.; "Induction and Direct-Current Motors," by Ralph D. Mershon, New York, N. Y.; "Relative Desirability and Efficiency of Various Types of Engines on Central Station Loads," by Prof. Richter, Wisconsin University; "A Life Test of Incandescent Lamps," by Prof. Shepardson, Minnesota University; "A Canadian Plant," by L. G. Van Ness, Quebec, Canada.

CABLE TERMINALS.—Among the patents of Jan. 2 are five on terminals for electric cables, three of which were issued to Willard L. Candee, one to Joseph N. Byers and the fifth to William Callahan. The object of the Byers invention is to provide a construction where the cable wires are connected directly to the terminal points without the intervention of insulated wire; and in insulating the terminal points, as also the ends of the cable wires, from each other, so that there can be no cross talk due to short circuits between adjacent terminals—such insulating material excluding moisture from coming in contact with either of the ends of the wires of the cable terminals, thereby preventing corrosion of such points. The invention also relates to a method of holding fuse wires, whereby a large proportion of the soldering now necessary is avoided. The Callahan patent refers to a cable terminal to be used in making connection with aerial telephone wires where it is necessary to place the same on poles or in any other place where a cable terminates. Its object is to furnish a neat and convenient means for making connections and with means for receiving and conducting away any accidental heavy charges from lightning or crossing of the lines from high-tension electric light wires; there is also provision for preventing the creeping of moisture into the strands of the cable at its terminal. The first of the three Candee patents relates to cables composed of a number of electric conductors individually insulated from one another by a braid of fibrous substance or by wrapping paper or other like material, which constitutes an insulating material, which, though having strong features of merit, is susceptible to attack or injury from moist air in the process of transportation and laying. Such cables are usually encased in lead sheathing, and to avoid entrance of moisture and to supply a portable terminal, it has been proposed to cover the end of the cable with a metallic cap. Such cap, however, is serviceable only during transportation, since it must be removed when the cable is laid in order to expose the ends of the several wires to be united, during which latter operation the ends of the wires are necessarily exposed; and if the ground be moist or the atmosphere be charged with moisture, the damage to the cable will be as great as if no metallic cap had been employed. To obviate this danger to insulation, the several wires of the cable are surrounded for a certain distance from the end of the section with an insulating material not susceptible to attack from moisture, such as okonite, rubber, gutta percha or similar material. The two sections are electrically united at a point inside the sheathing of the cable, which is usually lead pipe. About three to six inches apart within the sheathing are two fixed sections of insulating material, preferably also of rubber, okonite or gutta percha, projecting from the surface of the insulated conductors and filling the space between the surface of such conductors. These sections unite the coating of the separate conductors together, and in effect constitute two impervious dams separated by a space of from three to six inches. Through a hole in the sheathing molten metal having a comparatively low melting point is run into the space thus provided until it is filled. The metal as it cools will adhere to the interior surface of the sheathing, and as it completely fills the interstices between the cable conductors, the passage of air and moisture is rendered impossible. The two other Candee patents relate to modifications of the above described method.

LETTERS TO THE EDITORS.

Paralleling Compound-Wound Dynamos.

To the Editors of Electrical World and Engineer:

Sirs:—In your issue of December 23, 1899, I note Prof. Anthony's letter, and also your editorial on the subject of paralleling compound-wound dynamos.

I myself have had some practical experience in this very connection which may be of interest to you. The main switch-board in the Astoria Hotel, which was designed by me early in 1896, and installed in the fall of 1896, seems to have been the first switch-board in New York in which the triple-pole dynamo switch, operated by one handle, was replaced by two switches, one of which, a single-pole switch, controlled one of the leads (the negative), while the other, a two-pole switch, controlled the other two leads (positive and equalizer).

It is proper to admit that the reason why this departure was made at the time was the difficulty, if not the impossibility, of doing the switching in one operation, especially for the larger units of the installation (250-kw each). Each switch had to be provided for a current capacity of 2500 amperes, and had to be made with multiple blades. The manipulation of a triple-pole switch of this capacity, especially when designed for low-current densities in contact and conducting parts, as in this case, was problematical. Hence, after considering many plans, including the idea of using single switches, it was decided to provide two switches, including one two-pole and one single-pole, as already stated. The fact that this was a new departure is proven amply by the circumstance that a "violation" was filed by the City Inspection Department, and also by the New York Board of Fire Underwriters on the ground that the dynamo switches did not comply with the then existing rule, which required that all three switch elements of the dynamo switch shall be operated simultaneously by the same motion.

It required a certain amount of persuasion to induce the inspection authorities to allow these switches to be used as they were, as there was at first a tendency on the part of the inspectors to insist upon their being replaced by switches of the conventional type. After the scruples of the Inspection Department had been overcome, the same arrangement was introduced in other switch-boards, notably the switch-board at Columbia University.

The instructions for operating the switch-board, which were at first given, were that the two-pole switch should be first closed, and that the paralleling of the dynamos should be accomplished in the manner recommended in your editorial, my reasoning being substantially the same as in your editorial of November 25. I was greatly disappointed, however, in the results. This method, while having certain theoretical advantages, proved unsatisfactory in practice, and the instructions were shortly after reversed; and ever since that time the practice has been to close the single-pole switch first, then to equalize the e. m. fs. and then close the two-pole switch. The fact is, that the old method requires less manipulation and is, on the whole, less likely to cause disturbance or a fluctuation of e. m. f. at the instant of completing the paralleling connection. The reasons for this are made sufficiently clear in Prof. Anthony's letter.

The method of first switching the series equalizer in circuit requires more manipulation of the shunt regulating rheostats, and possibly more skill; at least that is what we find in actual practice. Besides, the disturbance produced at the instant of connection is greater than with the other method. It seems to me that the difficulty would be rather increased than reduced in the case of over-compounded machines, the reason being that with such machines a greater portion of the exciting field is obtained from the series winding, and the effect of shunting the series coils of the dynamo already in by that of the incoming dynamos is all the greater. On coupling the series winding of the incoming machine, the total magnetic field of the dynamos already in circuit is consequently reduced to a greater extent, and a perceptible "dip" in the e. m. f. is always noted, which the operator cannot wholly obviate even when he quickly manipulates the shunt-regulating rheostat, not only of the incoming machines, but of machines already in circuit. This dip and the necessity of these prompt manipulations of the regulating rheostats were, in fact, one of the great disadvantages of the method. After the e. m. fs. have been equalized, and after the one-pole switch has been closed, further manipulation of the shunt rheostats is, of course, necessary to properly equalize the loads; this manipulation must be made at all of the machines.

In practice I do not consider the method to be particularly advantageous, excepting for very large units. For very large units operated under central station conditions, under the control of careful attendants, the method has, in my opinion, the specific advantage of enabling a better control to be made of the amount of current taken by the machine coupled in, at the instant of completing the connection. With the older method, this control is effected usually by balancing the e. m. fs. only partially instead of fully. Usually a difference of one volt or less is sufficient.

To sum up, the new method has some theoretical advantages, and is perhaps that which is theoretically preferable, and by means of which the paralleling can be effected with the least *load* disturbance.

and under better control, when used intelligently; but for practical purposes, especially for units not exceeding 200-kw in capacity, and for lighting loads where fluctuations of *voltage* are objectionable, the older method is preferable.

In referring to the older method, I include not only the single triple-pole arrangement, but also the double switch outfit, which, as already shown, fulfills the same function when the single-pole switch is closed first instead of last.

It is interesting to note that the "dip" of e m f referred to as occurring at the instant when the connection is completed, when paralleling by the new method, is influenced by the relative proportions of the incoming dynamos and of the dynamo or dynamos already in circuit. For instance, on attempting to couple by the new method a (115-volt) dynamo of small capacity (say 25 to 50-kw), with a dynamo of twice or thrice that capacity (say 75 to 150-kw), the "dip" will be relatively small. It may be as low as one volt and will not usually exceed five volts. If the situation is exactly reversed, however—that is to say, if the incoming dynamo has the larger capacity—the "dip" is not likely to be less than five volts, and it may be as much as fifteen or more. This experimental fact becomes at once intelligible, when we remember that the series winding of a small dynamo has a higher resistance for the same compounding, and consequently produces less shunting action on the series coil of the larger dynamos, and *vice versa*. I have not found any satisfactory way of overcoming this "dip," which is very objectionable, if not fatal, when the dynamos are used for lighting. The more "series" field there is the worse the dip, as experience amply proves.

NEW YORK, N. Y. C. O. MAILLOUX.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Running Alternators in Parallel.—BENISCHKE.—A long illustrated article discussing the difficulties in the parallel working of alternators. For good parallel working, it is necessary first that the alternators are in step, and, second, that the equalizing current is below a certain limit. The latter will be the case when the first condition is fulfilled, and when, furthermore, the voltages at the terminals of both machines are equal and their voltage curves do not differ too much. If the first condition is met and the voltage curves are nearly equal, an equalizing current occurs only when the e. m. fs. are unequal; by this current the voltages at the terminals are equalized; in the alternator with the higher e. m. f. the difference of phase between e. m. f. and equalizing current is a little less than 90°, in the other alternator a little more than 90°, the greater part of the equalizing current being wattless. He then discusses the case in which both alternators are equally excited, but out of step; the quicker one then has the larger e. m. f., and the result is again an equalizing current which accelerates the slower machine, the greater part of the current consuming watts. In general, both types of equalizing current occur simultaneously: that caused by unequal excitation and that caused by unequal speeds. The first can be prevented by the proper adjustment of the magnet regulators, the second by adjustment of the speed regulators, which, however, is sometimes very difficult. Some cases are discussed in which the second current is so large that the parallel working is not possible any more; but they occur only when one or both machines are coupled direct to steam engines. If driven by means of belts, ropes or turbines, such an equalizing current may occur if the forms of the curves of both machines are essentially different. Some special cases with symmetrical and with unsymmetrical voltage curves are discussed and explained with the aid of diagrams. The case in which alternators connected in parallel fall out of step, occurs with machines coupled direct to steam engines, when they begin to surge, and was explained by Kapp as a phenomenon of resonance; he endeavors to show that this is not correct, but that it is a phenomenon of interference or superposition. He points out that every direct coupled machine has a lack of uniformity in the speed during a revolution and that the periodic lack of uniformity can be replaced by a rotation of uniform speed and by a superposed oscillation which is analogous to the oscillation of a physical pendulum, and the period of which is equal to the impulses caused by the motion of the piston. A very effective damping of the amplitude of this oscillation can be accomplished by Leblanc's amortisseur (which was described under electric progress, S. P. Thompson, Digest, Dec. 16); the action of this amortisseur is entirely analogous to that of Waltenhofen's pendulum, consisting of a copper plate, the oscillations of which are damped at once by eddy currents induced in it when cutting through a magnetic field. The phenomenon of surging of parallel connected alternators is explained by a mechanical model which is illustrated.—*Elek. Zeit.*, Dec. 14.

Short Circuit Curve of Alternators.—ROTHERT.—A communication in which he corrects a mistake in his article, noticed in the Digest Sept. 30 and Oct. 7. Concerning the criticisms of Goldschmidt, Ziehl and Behrend (Digest, Oct. 7, Nov. 4, Dec. 23) he says that they have not understood his article and that the numerical examples of Behrend are entirely inappropriate.—*Elek. Zeit.*, Dec. 21.

HEYLAND.—A communication in which he also points out that Behrend's example in inappropriate. All known methods to determine the drop of voltage in the armature of alternators may be divided into two systems: In the first, recommended by Behn-Eschenburg and Kapp, it is the fields, namely, the main and the armature field, that are combined; in the second, recommended by Rothert, and recently also by Kapp, it is the ampere windings, namely, those of the field and of the armature, that are combined. By both methods the same results are reached as long as the saturation of the iron is low; an advantage of the second method is that the constants used in it can be predetermined, while in the first method experiments are necessary for that purpose. For high saturation, exact results may be obtained only by the second method.—*Elek. Zeit.*, Dec. 21.

ARNOLD.—A communication on the same subject. He says that the first of the above methods gives too high, the second too low values of the voltage at the terminals, and that the exact intermediate value depends upon the conditions of straying. If the method of combination of the ampere windings is used, as by Rothert, the results are correct only when the straying is small or the saturation of the field magnets low. For higher saturations the influence of the increase of straying should not be neglected. The inductor type always has high saturation and large straying, so that Rothert's method gives too high values of the voltage at the terminals. For the alternating pole type the conditions are different and more favorable to the use of Rothert's method. He then shows that it is easy to consider the influence of the increased straying if the system of combining ampere windings is used. His method is illustrated by a diagram and based upon the supposition made by Schueler that for a constant, useful field the stray field increases in the proportion of the increase of the field ampere windings.—*Elek. Zeit.*, Dec. 21.

Synchronous Converters.—EBORALL.—The conclusion of his article (Digest, Jan. 6). He refers to the tramway installation for the town of Sofia, where there will be a generating station driven by water power at a considerable distance from the town. Three-phase high voltage current will be generated and sent over aerial lines to a substation in the town, where it will be transformed into continuous current by transformers and overcompounded synchronous converters. But as the water power available is very variable and might, under certain circumstances, fail altogether, these converters will be coupled to vertical engines, so that, if necessary at any time, they can be used as ordinary railway generators to supply the tramway system wholly or partly with current.—Lond. *Elec. Rev.*, Dec. 22.

Armature Connections.—GIRAULT.—A short article on the proper shape of the curves to which the armature windings should be bent at the two ends of an armature, when the coils are form-wound, or when the end connections of armatures with bars are shaped like those in form-wound coils. The correct curve is evidently one which is always equally distant, measured normally to the curve, from its neighbors at all parts of the curve; the proper curve is therefore an

evolute of a circle, that is, a curve traced by any point of a string which is being unwrapped from the circumference of a circle; two neighboring curves are therefore those traced by two points of such a string. He shows how the elements of these curves may be calculated and gives a table of values which greatly simplify the work in practice; several problems are worked out analytically. As the space for these end connections is limited, it is rarely possible to shape these curves correctly, and he therefore suggests a simple approximate method which consists in drawing one evolute from the proper point on the circumference inwards and another from the point on the smaller inner circle, toward the outer; then sketch in a curve which terminates in these two points and approaches as closely as possible the shape of both of them.—*L'Ind. Elec.*, Nov. 25.

Commutator.—Three communications discussing the various reasons which have led to the use of commutators which are much larger in diameter than formerly, and pointing out that there is no definite rule for the best ratio between length and diameter, as the best dimensions depend upon the type of machine and the type of centre. In general, the diameter should be made as large as possible; the point at which the increased copper cost, due to the increased diameter, becomes greater than the diminished iron cost, gives a limit.—Lond. *Elec. Eng.*, Dec. 22.

Standard Periodicities.—An article referring to the proposal of a committee of the English Institution of Electrical Engineers, to adopt 50 periods per second for all ordinary work, 25 periods per second for power transmission on a large scale, and 100 periods for exceptional cases of house-to-house transformer supply. (The rules of the Amer. Inst. Elec. Eng. say: "In alternating current circuits, the following approximate frequencies are recommended as desirable: 25 or 30, 40, 60, 120. These frequencies are already in extensive use and it is deemed advisable to adhere to them as closely as possible.") He then says that not a single English engine firm has adopted a line of speeds which fit in with the suggested standard periodicities, and that to adopt standard periodicities at all, the initiative must come from the makers of high speed engines. In a table he gives the number of revolutions per minute of an alternator or synchronous motor, when the number of poles varies between 4 and 52, and the periodicity per second is 25, 50, 100 respectively; also the number of revolutions per minute of an induction motor with 7½ or 5 or 2½ per cent. slip. He remarks that on account of mechanical reasons and the magnetic leakage, the number of poles for a given size of motor cannot be exceeded with a given output. The synchronous speeds and the most convenient number of poles to use for a periodicity of 50 per second, are given as follows: Up to 7-hp the synchronous speed 1500 revolutions per minute, the number of poles in stator, 4, probable slip 7½ per cent.; from 7 to 35-hp 750 revolutions, 8 poles, 2½ per cent. He says that a 7-hp motor could be built with eight poles, in which case the synchronous speed would drop to 750 revolutions per minute, but it would not be advisable to go much beyond that number.—Lond. *Elec. Rev.*, Dec. 22.

REFERENCES.

Theory of Alternators.—BLONDEL.—A continuation of his mathematical article (Digest, Dec. 9), discussing the voltage drop in an alternator when the saturation of the magnetic circuit is appreciable, and the experimental determination of the constants in his equations.—*L'Ind. Elec.*, Dec. 10.

Alternators.—LEBLANC.—An article on the influence of the self-induction on the utilization of the material in alternators, discussing the advantages of a special exciter devised by him.—*L'Eclairage Elec.*, Nov. 25.

Enclosed Motors.—WALKER.—A reprint of the article noticed in the Digest Jan. 6.—*El'ty*, Jan. 3.

LIGHTS AND LIGHTING.

Public Arc Lighting.—CARTER.—The first part of an article on the "scientific principles of public lighting by arc lamps." He gives definitions of the term candle-power, photometric curve of a source, explains the term candle-foot, develops the law of inverse squares, and shows how to calculate analytically the total, horizontal and vertical illumination at any point, due to an arc lamp, if the photometric curve of this lamp is given.—Lond. *Elec. Rev.*, Dec. 22.

REFERENCES.

Spectrophotometry of Arc and Incandescent Light.—GAUD.—A paper giving an account of experiments in which he compared the light emitted by an incandescent lamp and by an arc lamp, with sunlight. The results for the different lengths of waves are given in a small table.—*Comptes Rendus*, Nov. 13; abstracted in *L'Eclairage Elec.*, Nov. 25; *L'Ind. Elec.*, Dec. 10.

POWER.

Electric Power in Quarries.—A well illustrated description of an electrical quarry installation in the Lowlands in Scotland. The economy of electric motors as compared with steam cranes and the facility of electric transmittion power from the railway siding to the centre of working are pointed out. The generating plant consists of two 80-hp direct coupled sets, generating continuous current at 500 volts. At the quarry there are seven 10-ton derrick cranes, each driven by a 15-hp enclosed motor, designed like the standard traction motor to withstand severe overloads and mechanical strains. Electric power is also used in the stone planing and cutting shops, where three 15-hp motors and three 10-hp motors drive the stone planers and sawing machines. The monthly coal consumption of the whole installation is about 90 tons at $1.87 per ton, using non-condensing engines and with cold boiler feed. Condensers are now being installed and it is anticipated that the consumption will then not exceed 65 tons a month, which is about one-third of the coal consumption, were the whole installation driven by steam.—Lond. *Elec. Rev.*, Dec. 22.

Electricity in Mining.—WARREN.—An illustrated article on the ore treatment in De La Mar's Mercur Mines, in Utah. The chemical processes are described in detail. The power for the mines and mill is supplied by three-phase electric transmission at 40,000 volts from Provo Canyon, 36 miles distant, reduced to 220 volts at the mills. There are some 17 motors varying from 150 to 5-hp, requiring a total of 500-700-hp. All the motors are of the two-phase induction type of the Westinghouse Co. The power supplied from Provo is not reliable, as it stops without warning; a steam plant is therefore being erected at the mines which will contain two 300-kw 22-pole generators at 200 volts and 7200 alternations, running 327 revolutions per minute.—*Eng. and Min. Jour.*, Dec. 30.

Electric Power in a Tobacco Factory.—An illustrated description of the installation of Liggett & Myers Tobacco Co., in St. Louis, where 1000-hp in electric motors is installed in machines, varying from 4 to 70-hp in size. The generating plant contains four dynamos of, together, 880-kw, giving continuous current at 220 volts. Saving of floor space has been accomplished by mounting the motors directly upon or above the machine to be driven. A "digger" is illustrated article noticed in the Digest Jan. 6. Mean pressures in the operation of digging; the motor and controller are located directly upon the framework, and connection is secured by a flexible cable.—*West. Elec.*, Dec. 30.

Utilization of Blast Furnace Gases.—The conclusion of the illustrated article noticed in the Digest Jan. 6. Mean pressures in the gas engine cylinders with blast furnace gas can be obtained as desired from 38 lbs. per sq. in. up to 60 and 70 lbs. per sq. in., and this without any risk of a miss in the ignition; six diagrams are given for mean pressures of 38, 54, 56, 60, 61, 74 lbs. Some remarks are added on actual installations.—Lond. *Elec. Rev.*, Dec. 22.

REFERENCES.

Refuse Destructor.—RUSSELL.—A reprint of the abstract noticed in the Digest Jan. 6.—*El'ty*, Jan. 3.

Steam Engines for Electric Traction Power Houses.—HAGUE.—The second illustrated part of his article (Digest, Dec. 16), discussing problems of design and erection of large steam units.—*Eng. Mag.*, January.

TRACTION.

Tramway Statistics.—MATTERSDORF.—An article based upon the statistics of five large German tramway companies, showing that if the earnings per car mile are plotted in a diagram as a function of the number of car miles per year, regular curves are obtained. It appears that the earnings per car mile increase up to a maximum which is reached when the most urgently needed traffic is provided for; if the number of car miles per year is then increased still more, the earnings per car mile decrease slowly, but continually. In two of the curves the maximum lies in the beginning of the company's existence.—*Elek. Zeit.*, Dec. 21.

Traction Plant.—MILLER, OTTERSON, EASTMAN, TALBOTT.—A brief account of a test of the Capitol Traction Co.'s power plant in Washington, the object being to find the efficiency and economy of the plant as a whole, under ordinary working conditions, for the entire 24 hours. The performance of the several parts of the plant is shown in a table. The coal consumed per i. h. p.-hour was 2.18 lbs., per elec. h. p.-

hour 2.21 lbs. The cost of coal per i. h. p.-hour is 0.204 cent, per e. h. p.-hour 0.207 cent, per e. h. p. per 3000-hour year $6.21.—*Eng. News,* Dec. 28.

Single Rail Tramway.—An illustrated description of a tramway invented by Ewing and in use in India, in which nearly the whole weight of the truck is borne on two or three double-flanged wheels running on the single rail laid on the surface, the necessary balancing support being afforded by a lightly constructed iron wheel of comparatively large diameter. Bullocks are generally used for haulage, but it is said that electric haulage would present no difficulties on a line of this description. A light trolley line carried on wooden brackets and locomotives of similar design to the trucks, would afford a cheap equipment suitable for light traffic on either a temporary or a permanent line.—Lond. *Elec. Rev.,* Dec. 22.

Return Currents.—WYNKOOP.—An illustrated article of general nature on the destructive effects of vagrant electricity. A number of corroded pipes are illustrated. He comes to the conclusion that at the present state of the art there is no other solution to the difficulty than that of banishing the single trolley system, as all the so-called remedies are claimed to afford no more than partial or temporary relief; he admits that at present there is no satisfactory substitute for the usual electric railway, and he therefore makes no suggestions concerning the remedies.—*Pop. Sc. Mo.,* January.

Automobiles.—BEAUMONT.—An article on the progress of the last two years in automobile construction in Europe. No radical change has been made, but there were numerous improvements in detail. As to electric automobiles, it is said that for town work and short radius runs, they are satisfactory and pleasing as to smoothness and quiet running. They meet the requirements of those who do not wish to go more than 25 or 30 miles per day, and of those who do not study the cost either of vehicle or of running or maintenance. The secondary battery is still a "thing of delicacy." As cabs, the electromobiles have failed in London; they are in a similar plight in Paris, and at present none of these electric vehicles appear likely to take the place of horse vehicles in commercial work.—*Eng. Mag.,* January.

Automobile.—An illustrated description of the Oppermann electric car. He builds complete underframes with a 3-hp electric motor and gear and road wheels, to which coach builders may fit their own bodies. The battery of 40 accumulators weighs 1288 lbs. and has a capacity of 150 amp.-hours. A complete car with four passengers weighs 2800 lbs., and covers a distance of 45 miles on one charge. It is said that the same firm is about to bring out a new, lighter type of accumulators, a battery of 40 cells weighing 896 lbs. and having a capacity of 150 amp.-hours.—*Ind. and Iron,* Dec. 22.

REFERENCE.

Trolley Cars.—BAXTER.—The first part of an illustrated article of a popular nature on "What makes the trolley car go?"—*Pop. Sc. Mo.,* January.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Charging for Electric Power.—A short article on the method of charging for power by the La Bella Mill Water Power Co., of Denver, Col. The charge of the power is made up of two parts: First, a fixed charge based on the size of the motor, and secondly a charge for the metered energy used. The total charge for an hp-hour is therefore less the greater the number of hours during which the motor is running at full load; this is shown in an empirical curve; the curve is independent of the power factor; the general basis is that a motor used 12 hours should earn twice as much per hour while in use, as a motor operated for 24 hours; thus the fixed charge is twice as much for 12 hours as for 24, the energy charge being nearly the same per unit; the fixed charge per hour varies with the hours during which the motor is used and is inversely proportional to these hours. From the curve which is given the following values are taken: For 700, 400, 200, 100, 40 hours per month per hp of motor, the charges "per hp-hour" are 12, 15, 22, 30 and 50 cents respectively. *Eng. News,* Dec. 28.

Mixed Systems.—An editorial article calling attention to the advantages of a mixed system of supply in which the nearby area is supplied with low pressure current and the distant districts with high pressure (presumably meaning alternating currents); Prof. S. P. Thompson in his recent presidential address expressed himself as an opponent of these mixed systems. It is stated that in Switzerland and America no hard and fast system is prescribed, each case being treated on its merits, intimating that such is not the case in England. Attention is called to the large loss in the magnetizing current of transformers, intimating that this could be avoided for nearby districts by the use of direct currents. In Sheffield 68 per cent. of the load is located within half a mile of the works, 78 per cent. within one mile, and 88 per cent. within one and a half miles.—Lond. *Elec. Rev.,* Dec. 22.

Cable Building Installation.—An illustrated article on the light, heat and power supply in the Cable Building in Chicago. The current, furnished by the Chicago Edison Co., is used for arc and incandescent lighting, for running the elevators, house pump and the surface-drainage pump. The electric lighting includes 28 arc lights of 2000-cp each, 600 incandescent lights of 16-cp each and 250 incandescent lamps of 10-cp each.—*West Elec.,* Dec. 30.

REFERENCES.

Milan.—HOSPITALIER.—A continuation of his well illustrated article (Digest, Nov. 25) giving a description of the Porto d'Adda power house, where seven turbines are direct coupled to seven 1590-kw alternators generating three-phase current at 13,500 volts effective. The overhead transmission line to Milan, 20.4 miles distant, is also described in detail.—*L'Ind. Elec.,* Dec. 10.

Small Central Stations.—HAYLER.—The paper in full giving "a few suggestions to the managers of small central stations," read before the Ohio Electric Light Association, and noticed in the ELEC. WORLD AND ENG. Oct. 21.—*West Elec.,* Dec. 30.

WIRES, WIRING AND CONDUITS

Standardization of Copper Constants.—A report of the committee on copper conductors. It was resolved that Matthiessen's standard of 0.153858 standard ohms resistance for a wire 1 meter long weighing 1 gram at 60° F. be taken as the standard for hard drawn high conductivity commercial copper; that hard drawn copper be defined as that which will not elongate more than 1 per cent. without fracture; that Matthiessen's standard of 0.150822 standard ohms resistance for a wire 1 meter long weighing 1 gram at 60° F. be taken as the standard for annealed high conductivity commercial copper; that copper be taken as weighing 555 lbs. per cu. ft. at 60° F., which gives a specific gravity of 8.912; that the average coefficient of 0.00238 per degree F. be adopted as temperature coefficient for commercial purposes; that the resistance and weight of conductors be calculated from the actual length of the wires; that a lay of 20 times the pitch diameter be taken as the standard for the calculation of cables; that 2 per cent. variation of resistance or weight be allowed in all conductors; that an allowance of 1 per cent. increased resistance as calculated from the diameter be allowed on all tinned copper between Nos. 22 and 12 gauge inclusive. The constants of the resistance of solid wires and of cables are given in two tables. These figures have been adopted by all the parties represented, and it is hoped they will become the universal standard for Great Britain. The Lond. *Elec. Rev.* remarks that according to the Wiring Rules of 1897 of the English Institution of Electrical Engineers, the resistance of a copper wire, weighing 100 grains, 100 inches long, should be taken as 0.1516 ohm at 60° F., which is about the mean between the above values for hard drawn and annealed copper. In a long editorial the Lond. *Elec.* points out that the committee was a self-constituted one and that, although general standards for copper wire are needed, some of the resolutions of the committee are not of a nature to be accepted without further consideration, by a large section of the electrical profession which was neither adequately represented on the committee nor asked to give evidence before it. The last two resolutions are said to be most open to criticism, that is, to allow 2 per cent. variation of resistance or weight in all conductors and 1 per cent. increased resistance as calculated from the diameter on all tinned copper between Nos. 22 and 12 gauges inclusive. A margin of 2 per cent. is thought to be excessive in the case of single bare wires, and inadequate for heavy cables of many strands, and it is asked, if such a margin is to be allowed, why state a standard of resistance to six significant figures and an arbitrary specific gravity to an eighty-ninth of 1 per cent. accuracy? The extra indulgence of 1 per cent. allowed to those manufacturers whose process of insulation necessitates that the conductors be tinned, is said to be unreasonable.—Lond. *Elec., Elec. Rev.* and *Elec. Eng.,* Dec. 22; *Lightning,* Dec. 21.

Aluminum Wires.—FLAMEL.—A short article in which he discusses the question whether aluminum wires can compete favorably with copper for telegraph lines, stating that they have been used in this way with success, but that the question of the advantages depends on circumstances. He gives the following constants for copper and aluminum respectively: Conductivity, 100 and 63; specific gravity, 8.93 and 2.60; weight corresponding to equal conductivity, 100 and 48; surface for equal conductivity, 63 and 100; diameter for equal

conductivity, 10 and 12.6. With these figures it is possible from the cost of the metal to find whether there is any advantage in using aluminum. Aluminum is claimed to have a strength of 15 to 20-kg per sq. mm., while copper has 25; considering, however, the greater cross-section of the aluminum wire for the same conductivity, the advantage in point of strength is with aluminum.—*La Nature*, Dec. 16.

MASSIN.—A discussion as to whether aluminum alloyed with a small quantity of copper can replace a silicon bronze to advantage for overhead telephone lines; he concludes that it cannot. He calculates the sag and the coefficient of safety for the extreme temperatures of the French climate; the coefficient of expansion due to temperature is 0.000023 for the aluminum alloy and 0.000017 for the bronze, and owing to the former being so much greater, the sag in warm weather would be greatly increased, or for the same sag, the factor of safety reduced in cold weather. Furthermore he adds that the aluminum is more easily attacked by atmospheric vapors. He concludes that under no circumstances should the aluminum alloy be used.—*L'Ind. Elec.*, Dec. 10.

Earthing Alternate Current Mains.—An editorial note pointing out the advantage of earthing one conductor of an alternate current system of high tension distribution. If concentric cables are used, the outer conductor is to be earthed, as it naturally tends to keep itself at earth potential. If an attempt is made to keep both poles insulated from earth, the conductor whose insulation resistance is least, tends to keep at earth potential; an earth, then, on the other conductor immediately strains the defective insulation on the first, and a breakdown occurs in which both conducting wires are disabled; this occurred recently in Hastings. When one conductor is permanently connected to earth at the central station, the voltage set up by the resonance effects is not likely to be quite so destructive as when both the wires are insulated.—Lond. *Elec. Eng.*, Dec. 22.

REFERENCE.

Wiring Between Two Poles of Different Heights.—JUELLIG.—An illustrated theoretical article in which he calculates analytically the mechanical stress in a line suspended between the ends of two poles of different height. The stress is a maximum at the point where the line is connected with the higher pole. Four numerical examples are given.—*Elek. Zeit.*, Dec. 21.

ELECTRO-PHYSICS AND MAGNETISM.

Luminescence of Electrodes.—TOMMASINA.—An account of experiments with Crookes tubes filled with distilled water, the electrodes being aluminum discs attached to platinum wires. The discs became luminous, and so did the supporting wires when of aluminum instead of platinum. The glow is essentially anodic and the luminosity, though apparently continuous at both electrodes, is really alternating. Only aluminum, and to a less extent magnesium, show this luminosity, and they only show it when immersed in water, alcohol or acidulated water, and not in dielectrics like petroleum or vaseline. —*Comptes Rendus*, Dec. 4; abstracted in Lond. *Elec.*, Dec. 22.

Chemical Action of Röntgen Rays.—VILLARD.—An account of experiments which show that Röntgen rays exert a chemical action not only upon photo-sensitive salts, but upon substances contained in some kinds of glass, so that radiographs may be obtained with simple glass plates. He studied the coloring action of Röntgen rays upon the tubes generating them, under different conditions.—*Comptes Rendus*, Nov. 27; abstracted in Lond. *Elec.*, Dec. 22.

Vacuum Tubes.—ROLLINS.—A continuation of his notes. For vacuum tube lighting he claims that the higher the vacuum the better the light; the "vacuum should be hydrogen and adjustable." To revive cheap Röntgen ray tubes, he proposes to have some chemical in a small supplementary bulb which liberates hydrogen when heated; sodium formate will do this. He proposes to support the stems of the terminals in a Röntgen ray tube by collars of mica or by rings of molded lava.—*Elec. Rev.*, Dec. 20.

REFERENCES.

Röntgen Rays.—VOLTA.—A description of experiments made to study the influence of elevated temperatures of certain bodies upon their behavior toward Röntgen rays.—*Il Nuovo Cimento*, v. 8; p. 241; abstracted in *L'Eclairage Elec.*, Nov. 25.

Conductivity of Crystallized Selenium.—AGOSTINI.—An investigation of the influence of electromagnetic waves upon the conductivity of crystallized selenium. An effect was observed, but it was not so distinct and large as that of light.—*Il Nuovo Cimento*, v. 8; p. 81; abstracted in *L'Eclairage Elec.*, Nov. 25.

Thermo E. M. Fs. of Lead-Bismuth Alloys.—SPADAVECCHIA.—A French abstract of the Italian article and the tables, noticed in the Digest Nov. 11.—*L'Eclairage Elec.*, Nov. 25.

Electrostatic Rotation.—DELL.—A description of several other ways of producing rotation, than those described in his previous articles noticed in the Digest Dec. 2 and 9.—*Elec. Rev.*, Dec. 20.

Conductors in Electrolytes.—STARK.—An account of a theoretical and experimental investigation of the case in which a current flows through a conductor surrounded by an electrolyte, so that the conductor is shunted by the electrolyte.—*Wied. Ann.*, v. 66; p. 245; a long illustrated French abstract in *L'Eclairage Elec.*, Nov. 25.

Theory of Atoms.—PLATNER.—The first part of a theoretical article on the mechanics of atoms, with special reference to chemical processes.—*Elektrochem. Zeit.*, December.

Transmission of Hertzian Waves Through Liquids.—BRANLY.—An investigation of the transparency of different liquids for Hertzian waves.—*Comptes Rendus*, Oct. 30; abstracted in *L'Eclairage Elec.*, Nov. 25.

Hertzian Waves.—TURPAIN.—A French Physical Society paper, giving an account of his experimental researches on the influence of different positions of the resonator, on the action of the resonator, and on the propagation of oscillations in dielectrics.—*L'Eclairage Elec.*, Nov. 25; *L'Ind. Elec.*, Dec. 10; abstracted in Lond. *Elec.*, Dec. 1.

ELECTRO-CHEMISTRY AND BATTERIES.

Aluminum Anode.—POLZENIUS.—A paper in which he gives the results of an investigation of the property of cells having one aluminum electrode, by virtue of which it lets only such currents pass for which the aluminum is cathode (Digest, Oct. 7, Dec. 23). He tested a large number of different electrolytes; he found that inorganic acids in general have only a slight action; sulphuric acid developed 20 volts; with phosphoric acid and fluoric acid up to 120 volts may be obtained; salts act better than acids; with bichromate of potash the voltage rises to 80 and the plate is covered with small sparks which make a hissing noise; much higher voltages even, than with phosphoric or fluoric salts, are obtained from organic acids and salts; when the voltage is very high the anodes become luminous. He mentions that a method of using this property for converting alternating into continuous current is in practical use in the Pollak accumulator plant, where the continuous current necessary for the accumulator tramway is obtained in this way from the alternating current of the municpal plant at Frankfort o. M. The batteries become heated and must be cooled.—*Elektrochem. Zeit.*, December.

Lead Accumulator.—MUGDAN.—A long illustrated account of a series of experiments, the results of which are in a very good agreement with the theory of Dolezalek, based upon the entire reversibility of the processes in the accumulator (Digest, Feb. 18, July 8, Aug. 26). He found that on both plates the sulphate and not the oxide is formed at once, so that the hypothesis of the primary formation of oxide and the secondary formation of sulphate from the oxide and acid, is disproved; his results are the more decisive, as he experimented with large current densities, short discharges and very dilute acid, which are conditions most unfavorable for the formation of sulphate. The e. m. f. of the accumulator is a function of the concentration of the electrolyte. The decrease of the e. m. f. during the discharge and the increase during the charge are not a result of the variation of the quantity of the sulphate; this variation influences only the internal resistance. The reason of the variation of the e. m. f. during charge and discharge is the variation of the concentration at the plates. After a discharge is interrupted, an accumulator recovers, as the exhausted acid in the pores of the plates is replaced by fresh acid from the electrolyte.—*Zeit. fuer Elektrochemie*, Dec. 7.

Engraving by Electricity.—LANGBEIN.—An article on a method of engraving dies by electrolytic etching, which was noticed in the Digest several years ago. A negative cast made of plaster of paris or any other porous material, and saturated with the electrolyte, is connected with the negative pole of an electric source. This is pressed lightly against the metal plate to be etched, which is connected with the positive pole. At the points where it touches, the metal is dissolved, thus forming the exact counterpart of the negative cast. To etch steel plates to a depth of 40 mils, which requires 4 to 5 hours, it is necessary to touch the plate with the negative about 600 to 700 times, each time for 12 seconds; in the interval between two periods of etching the steel plate is brushed off, to remove the insoluble materials contained in the steel such as carbon and silicium; this is accomplished by an adjustable mechanical device. Great difficulty was experienced in getting a good quality of plaster, as it must

be hard and its porosity should be neither too great nor too small. The best electrolyte for etching steel is a solution of 10 per cent. of chloride of ammonium, with some hydrochloric acid. The best current is 1.3 amperes per square inch, at 8 to 12 volts, the voltage must be smaller in the beginning of the process. This process is to be used extensively by a recently formed German company.—*Zeit. fuer Elektrochemie,* Dec. 7.

REFERENCES.

Variation of Polarization With Pressure.—FEDERICO.—An investigation of the influence which pressures between one and 1000 atmospheres have upon the e. m. f. of polarization of solutions of sulphuric, nitric and hydrochloric acid.—*Il Nuovo Cimento,* v. 8; pp. 145, 409; abstracted in *L'Eclairage Elec.,* Nov. 25.

Potential Difference Between Electrode and Electrolyte.—KAHLENBURG.—An account of a long series of measurements of single potential differences between metals and solutions of their salts in several solvents.—*Jour. Phys. Chem.,* 3, p. 379; abstracted in *Zeit. fuer Elektrochemie,* Dec. 7.

Surface Tension and Specific Gravity of Solutions.—ARCHIBALD.—An article in which he applies the dissociation theory to represent the surface tension and the specific gravity of some aqueous solutions as functions of the ionization.—*Elektrochem. Zeit.,* December.

Electrolytic Oxidation of Succinic Acid.—CLARKE and SMITH.—An account of a series of experiments, in which tartaric acid neutralized with soda and dissolved in alcohol in a porous cup, was the anode electrolyte, and soda lye the cathode electrolyte.—*Jour. Am. Chem. Soc.,* 21, p. 967; abstracted in *Zeit. fuer Elektrochemie,* Dec. 7.

Electrolytic Methods in Analysis.—LILY KOLLOCK.—An examination of several electrolytic methods, used in metal analysis.—*Jour. Amer. Chem. Soc.,* 21, p. 911; abstracted in *Zeit. fuer Elektrochemie,* Dec. 7.

Calcium Carbide.—CARLSON.—An article discussing the advantages and disadvantages of finely powdered and of granular raw material for the production of calcium carbide; he favors the latter.—*Zeit. fuer Elektrochemie,* Dec. 7.

UNITS, MEASUREMENTS AND INSTRUMENTS.

REFERENCES.

Alternating Current Wattmeter.—GOERNER.—A long illustrated abstract of a paper on the alternating current wattmeter of Hartmann & Braun, referred to in the Digest Nov. 25; the present paper gives some supplementary notes. The mathematical principles of the production of a rotary field by combination of two alternating fields, are discussed and explained by diagrams. The equations upon which this wattmeter and an older ampere-hour-meter of Bruger are based, are developed.—*Elek. Zeit.,* Dec. 14.

Meters.—ARMAGNAT.—A continuation of his article giving brief, illustrated descriptions of new types of meters, taken from patent specifications (Digest, Dec. 2).—*L'Eclairage Elec.,* Nov. 25.

Mercury Jet Interrupter.—LEVY.—A reprint, with the illustration, of the English abstract noticed in the Digest Nov. 25.—*Elec. Rev.,* Dec. 27.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy Without the Coherer.—STARKEY.—A short description of experiments with a new electric wave detector. The transmitting apparatus consists of an aerial wire surmounted by a metal cube, electric oscillations being excited in the conductor by sparks from a Wimshurst machine. The receiving apparatus consists of a delicately suspended needle of silver foil; the pivot on which it is suspended is connected to earth. Near one end of the needle is mounted a second aerial conductor mounted on an insulating stand. The end of the needle is adjusted so that it is quite close to the conductor, but is not in contact with it. When sparks pass at the transmitter, the end of the needle is strongly attracted by the conductor which movement can be used to ring an electric bell. With this he succeeded in ringing an electric bell at a distance of 36 feet. The movement of the needle is not due to an electrostatic field, as no movement is observed till the sparks pass at the transmitter.—Lond. *Elec. Rev.,* Dec. 22.

Independent Telephone Systems.—MILLER.—An article on the development and the prospects of the independent telephone companies, and on private installations in factories, stores, etc. A factory telephone system may be installed on one of two general plans. The first is the house or intercommunicating system, in which each telephone has an individual wire to all of the other instruments, so that no operator is required; each telephone has a simple switching device, but a great disadvantage is that it is necessary, when through with a conversation, to switch the instrument back on its own line in order that it may be ready to receive a call from another station. He recommends this system for small plants only. The second plan, the central station system, requiring a switchboard attended by an operator, should be followed wherever more than ten instruments are installed. He gives an itemized list showing the cost of a very complete interior system of twenty instruments actually installed on the common battery plant; the total cost is $511.—*Eng. Mag.,* January.

Electrical Time Service.—HOPE-JONES.—An illustrated abstract of a paper read before the English Institution of Electrical Engineers. He divides electric clocks into two classes: Independent, self-contained, self-wound clocks, and system of clocks connected together by a line and controlled by a master clock. He describes a number of electric clocks devised by others. He favors step-by-step dials operated by a master clock which is electrically driven and transmits a current every half-minute to the independent dials in series. The mechanism of the master clock and the device for the movement of the dials in his system are illustrated. The series connection is said by one of the journals to be a drawback.—Lond. *Elec. Rev.,* Dec. 22, briefly; longer in Lond. *Elec.,* Dec. 22, and *El'ty,* Jan. 3.

REFERENCE.

Cable Projects.—A long editorial advocating the laying of submarine cables, subsidized by the German government, in opposition to the English monpoly.—*Elek. Zeit.,* Dec. 21.

MISCELLANEOUS.

Electric Heating.—An article of a general nature on the electrical heating industry in England at the present time. The advantages of the following apparatus for manufacturing and industrial purposes are briefly discussed; flat irons for laundry purposes, of which there is an installation of 200 irons, the general cost of working of which was found to be less than with similar gas irons; two degrees of heat are used, one requiring 300 watts and the other 500 watts; the latter is liable to give trouble, if the iron is not switched off almost immediately when not in use; electrically heated rolls for laundry use; goffering iron heaters; hot plates and glue pots for woodworkers' shops; hot plates and stoves for lacquering purposes, which are coming into very general use; goose irons for tailors' use. As to electric heating and cooking for domestic purposes it is said that with current at 2 to 3 cents per kw-hour, the cost of heating houses or cooking meals throughout, will not be excessive, provided some other means is adopted of heating the large quantities of water required for washing, baths, etc. For electric heating, reserve apparatus should always be kept on hand. The well-known advantages of electric radiators are pointed out. As an average, 500 watts are required per 1000 cubic feet of volume (he does not seem to consider the temperature) and the full power is to be switched on for two and three hours during the coldest winter days, for first heating the room up to about 65° F., after which it can be reduced to a third or a half. The best design of electrical radiator is made to have a free circulation of air through it, so that it acts both as an air warmer and a radiator. The cost of the heat radiators complete with accessories, is given in the following numbers: Rooms up to 1000 cubic feet in volume at $1.50 per 100 cubic feet; rooms up to 2500 cubic feet at $1.12; rooms up to 5000 cubic feet at $0.87. Some remarks are added as to electric heating and cooking apparatus used as a supplement to existing systems.—Lond. *Elec. Rev.,* Dec. 22.

Electric Fish.—GOTCH.—An abstract of a lecture before the Royal Institution of Great Britain on the electric fish of the Nile, chiefly the malapterurus. The organ is described and some of the properties of the shocks are given; the shock is rarely if ever a single one, as there is a rhythmic series of electrical changes occurring, one after the other, with a frequency of 100 to 300 per second, depending on the temperature; this is due to self-excitation; he compares it to a self-loading and self-discharging automatic gun; the total e. m. f. of an 8-inch fish can reach 206 volts, the organ being composed of about two million discs; the fish is incapable of sending a second impulse until it has had a rest of one-tenth of a second, or more when fatigued.—*Science,* Dec. 29.

Electrical Cranial Osteotome.—A short note describing a cranial osteotome, devised by an English surgeon, Dr. Robinson. It consists of a revolving drill worked by an electric motor and equipped with the necessary guards to adjust the depth of cut to the thickness of the skull. The current is transmitted to the drill by a hollow tube which also carries an irrigating antiseptic solution serving to keep

the drill cool and to remove the bone fragments.—Lond. *Elec. Eng.*, Dec. 8.

Popular Science Monthly.—Some changes will be made in Appleton's *Popular Science Monthly* beginning with the January number. The topics discussed are to be given a broader range and the philosophy of science which was formerly the prominent feature, is to give place to the facts and principles which apply directly to the concerns of everyday life. Distinguished specialists will be engaged to write on their respective subjects.

REFERENCES.

China.—LORD BERESFORD.—An abstract of an address delivered before the Institution of Mechanical Engineers on the opening for mechanical engineers in China, and discussing also the development of the electrical industry in China and Japan.—Lond. *Elec.*, Dec. 8.

Magnetic Separation.—LANGGUTH.—An historical outline showing the development of the methods for magnetically separating metals.—*Zeit. fuer Elektrochemie*, Dec. 7.

Congress of Russian Electrical Engineers.—A note stating that on Jan. 8, 1900, there will begin the first congress of Russian electrical Engineers in St. Petersburg.—*L'Ind. Elec.*, Nov. 25.

New Books.

THE INTERNAL WIRING OF BUILDINGS. By H. M. Leaf. Philadelphia: J. B. Lippincott Company. 200 pages, illustrated. Price, $1.50.

In estimating the value of some technical books, it becomes necessary to take into account the nationality of the people for whom it is written, their peculiarities, their geographical location and the climatic conditions. In no case could this be more true than in the book recently published in England on "The Internal Wiring of Buildings," by H. M. Leaf.

While this work may be valuable to the English engineer or contractor, its value in this country is confined to giving us a fair idea of the prevailing methods employed in interior wiring in England, and in so doing it shows conclusively that America is superior to the mother country in other things beside yacht racing. As a matter of fact, if this book truly reflects the present practice in England, they have barely reached the point in interior wiring which we passed some five or six years ago.

As an instance of this, the author opens chapter IV. by this statement in regard to "jointing." "One of the most important, if not the most important, part of the wiring of buildings is the making of proper joints in the conductors." He then proceeds at great length to describe methods of making joints and the trouble and dangers arising from joints improperly made. Because we fully appreciate this point in this country, we generally prohibit joints or splices being made at all. In fact, very few specifications are now written which do not absolutely prohibit joints except at fixtures, where is it impossible to avoid their use.

The tap system of wiring (which is largely to blame for most joints and splices) is described minutely in this work, and while the author does not actually recommend it, he does not condemn it. The loop system of wiring, which is used almost entirely in this country, and which dispenses with joints, is apparently not in favor in England. The only remedy the book has to suggest for avoiding joints is given in one paragraph as follows: "In order to avoid having any joints made in conductors, some engineers so arrange the wiring that the conductors are integral from each point of light. This system is extremely expensive, but is largely used in shipwork, where salt water is certain to find out any weak places in badly made joints. It is not usual to employ it in buildings on account of the cost and the multiplication of conductors it entails. It is entirely unnecessary to run a separate circuit from the cut-out centres for each point or outlet, but by the loop system as practiced here, the circuit is run successively to each outlet, and the wires need not be cut at all from the first to the last outlet, and no joints need be made."

In regard to the encasing of conductors, the author says that, "by far the larger proportion of buildings that are wired have wood-casings fixed to protect the conductors, and although many objections have been made to this form of protection, the fact remains that it still finds favor with most electricians, and appears likely to do so in the future, where the conductors are favorable to its employment." There is no question that wood molding should be absolutely abolished, and it probably will be entirely abolished in this country within a few years. The author is inclined to frown on lined iron conduit, for he makes this statement in regard to it: "The expense of using tubing of this description is considerable, and it is doubtful for this reason if it will ever come into extended use!" It would probably surprise him to know that not thousands but millions of feet of this very kind of conduit were used in New York City alone last year.

A lengthy description is given of a kind of conduit ("simplex" conduit), in which the joints are not threaded, but merely slip into the couplings and elbows, and with special bends, called inspection bends, which are "provided with a lid in order that joints can be made and inspected at any time if necessary." Apparently he believes in giving the contractor every inducement to make joints on every and any occasion—exactly the opposite of our position in this country. The chapter on concentric wiring is extremely interesting, but it will hardly lead to any modification in the methods in vogue here. The description and cuts of outlet and junction boxes, and of similar appliances, are very meager, and could have been dwelt on at greater length to advantage.

The question of testing is given too much prominence and space. However, with the methods of wiring described and the number of joints which apparently are made, it is undoubtedly necessary for the English engineer and contractor to do a great deal of testing.

ELECTRIC MOTIVE POWER. The Transmission and Distribution of Electric Power by Continuous and Alternate Currents. By Albion T. Snell. Sceond Edition. The *Electrician* Series. New York: The D. Van Nostrand Company. 420 pages, 425 diagrams and illustrations. Price, $4.00.

There are several new features in this edition, the first to arrest the attention of the reader being a frontispiece consisting of saturation curves for six kinds of iron and steel. The ordinates of these curves are graduated in gausses and lines per square inch, and the abscissæ in amperes per centimeter and per inch, constituting a very useful and convenient form of curves.

The first portion of the book has very little new matter. At the ends of Chapters III. and V. there are some additions, as also in Chapter VI. From Chapter VIII. to the end of the book the additions and alterations are more extensive, especially toward the end. Another new feature is a folder, facing page 4, containing a table of useful equations. The equations are arranged in two columns, those in the first column being expressed in the hybrid British metric units and those in the second column in pure metric units, which is a very good arrangement from a practical point of view, but the captions of these columns are open to criticism. The first column bears the caption "Inch-Pound-Minute System," although it contains watts, volts, webers, foot-pounds, pound feet, horse-power, radius in feet and distance in yards. The second column bears the caption "Centimetre-Gramme-Second System," while containing units of the "practical" system, meters, meter-kilograms, force de cheval, etc.

One meritorious feature of the book is the complete system of indexing. There is in the front of the book the usual table of contents, and in the back a general alphabetical index, an index to illustrations, a list of tables of data and tests and a list of formulæ. There ought to be no difficulty in finding anything in the book.

There are many applications of electric motive power treated in the book, but there are others omitted which are quite important, at least in American practice, such as the operation of printing presses, calico printing machinery, machine shop tools, etc.

NEW YORK RAILWAY LAW; CONSTITUTIONAL AND STATUTORY. Provisions Affecting Steam, Cable, Electric and Other Railroads, with Decisions and Forms. By Edward H. Wells. Albany: Banks & Co. Second Edition, 1899. 826 pages. Price $2.50.

This is practically a reprint of a first edition, issued in 1892, and is brought down to date by the addition of over 150 pages. The work is a good illustration of the rapidity and frequency with which statutes are amended. The original work contains the amendments of 1892, which, as the author says, were then believed to have reduced the railroad law to a permanent form; and yet its 171 sections have, in the seven years following their enactment, been amended in between forty and fifty of the sections. It is a book for the railroad officer, as well as the railroad lawyer. We cannot commend it as a treatise upon negligence law, or as a complete digest of all reported cases, but as a compendium of the constitution and statutes and all amendments to date, and as containing a valuable set of forms, we have no hesitancy in saying that the book is a useful one.

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BOOKS RECEIVED.

THE MANUFACTURE OF CARBONS FOR ELECTRIC LIGHTING AND OTHER PURPOSES. A Practical Handbook. By Francis Jehl. New York: D. Van Nostrand Company. 232 pages, 83 illustrations. Price, $4.00.

ELECTRICAL TESTING FOR TELEGRAPH ENGINEERS. By J. Elton Young. New York: The D. Van Nostrand Company. 264 pages, 89 diagrams. Price, $4.00.

ANNUAIRE POUR L'AN 1900. Par le Bureau des Longitudes. Paris: Gauthier-Villars. 800 pages. Paper. Price, 1 franc 50 centimes.

Directory of Electrical Societies, Etc.

INDIANA ELECTRICAL SNGIOEERING SOCIETY. Next meet Purdue University, Lafayette, Ind., Feb. 1-3, 1900.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting Kansas City, Mo., October, 1900.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting Chicago, 17, 1900, at Brooklyn Bell Telephone Station, 81 Willoughy Street, 8:30 a. m.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, New York. Next meeting Jan. 17, 1900.

NEW YORK ELECTRICAL SOCIETY, New York. Next meeting Jan. 24, 1900.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting Milwaukee, Wis., about Jan. 17, 1900. (See Current News and Notes.)

CHICAGO ELECTRICAL ASSOCIATION. Next meeting Jan. 19. Paper by B. J. Arnold.

Banners on the Outer Wall.

The American Telephone Company, of Chicago, has been sending out lately large quantities of its sign intended for telephone toll station work. It is a striking and conspicuous bit of decoration, and can be adapted to the requirements of any company that uses it, although the design itself is standard, and, we understand, copyrighted. Once seen, it is not likely to be forgotten. A cut of it is given herewith of the sign.

The Moloney Transformer.

The accompanying illustrations show the type A transformer of the Moloney Electric Company, of St. Louis, Mo. Fig. 2 shows the transformer complete, and Fig. 1 the core and coils.

The transformer has been designed to reduce the core and copper losses to a minimum, and to so proportion the two losses that the all-day efficiency shall be a maximum without any sacrifice in regulation. Magnetic leakage has been reduced, it is claimed, by the construc-

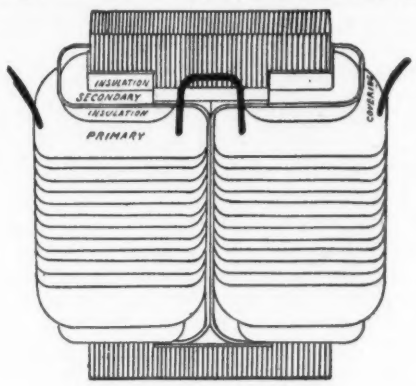


FIG. 1.—CORE AND COILS.

tion employed, so as to be practically nil, being, in fact, so insignificant that it is hardly discernible under the severest tests. To avoid eventual loss of insulation through vibration of the core and motion set up by the attraction or repulsion of the wires which occurs under the influence of alternating currents, the cores are compressed under very high pressure—the construction making this possible—the wires are wound on the coil under great strain and the very best kind of insulation is used. In this manner there is no possibility of vibration, either in the wires or in the iron, a proof of which is the absence of the sound which accompanies the deteriorating effects of vibration.

A special insulation has been used, experiment with the kind usually employed having shown that it is not satisfactory for high-

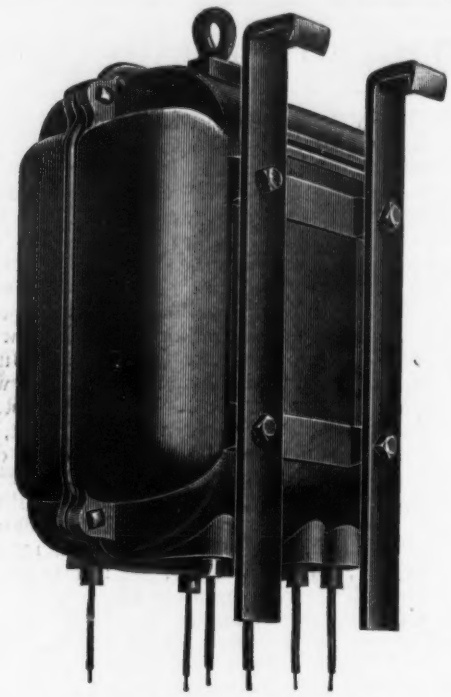


FIG. 2.—TRANSFORMER COMPLETE.

class work. Much care is exercised in the selection of iron, not only for magnetic qualities but to avoid any possibility of a transformer deteriorating through the ageing effect.

Sprague Electric Company.

The Sprague Electric Company is now well settled in its new headquarters in its own well-known factory property, 527 West Thirty-fourth Street, where the offices were carried on formerly before the development of the Sprague elevator business, now handled separately. The whole executive and personnel is now concentrated at this west side factory, with great gain in the expedition of business, which has been very carefully systematized and will be carried forward by well-defined departments. The officers, all of whom are active in the direction of affairs, are Messrs. John Markle, president; E. C. Platt, first vice-president; Allan C. Bakewell, second vice-president and general manager; C. P. Geddes, treasurer; D. C. Durland, assistant general manager. Messrs. Frank J. Sprague and Robert Lundell are retained as the consulting engineers of the company, and have supervision of the engineering staff and work, while Mr. E. T. Greenfield is in charge of the conduit engineering. The sales department is managed by Messrs. Bakewell and Durland, who have as a staff in that branch Messrs. C. L. Pease, W. H. A. Davidson, E. Wattlington and F. B. Smith. The conduit sales and exploitation has been turned over to Mr. Alex. Henderson, who has long made a specialty of this field. The electrical engineers of the concern are Messrs. George Hill, Hugh Pattison and Frank Shepard, the latter devoting his energies to the Sprague multiple-unit system. Mr. H. M. Davis is in charge of the publicity department. At the Thirty-fourth Street factory Mr. W. T. Ruete is in charge of the conduit work, which has always been carried on there, and which is being pushed on all the old lines as well as in the new classes of rigid insulated, flexible, armored cable, and flexible bell wiring, etc., thus including all sizes that can possibly come within the interior distribution art. At the Watsessing factories, in charge of Mr. Fred. Scheffler, a large variety of work is done, including all the Lundell dynamos and power motors, the fan motors, Sprague elevator apparatus, Sprague multiple unit system, Sprague controllers, etc. The Lundell dynamos are now made from ¼-kw up to 50-kw, with single field coil, and the motors of the same type from 1-12th up to 80-hp. The new line of dynamos of the six-pole type has been carried up to 150 and 200-kw for direct connected and 300-kw and 400-kw for the belted type. In all branches the company is very busy and is looking forward to a most prosperous year.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET advanced with a steady recovery which in some quarters has gone so far as to lift prices well up to the levels of the old year. But for apparent financial weakness in Berlin, coming on top of the depression in London, both conditions leading to the sale of American securities in Europe, prices might have advanced even further than they have done. But probably things are best as they stand. The period of panic has not so long gone by that people can forget it. One feature of the times is the freedom with which various stocks are assailed by bears who stay under cover—operators like cuttle fish darkening the waters in order to attack more effectively. Western Union is one of the latest to be driven at in this fashion. Recently it was Brooklyn Rapid Transit. During the week, however, Western Union went up 2 to 87 on 8601 shares. Brooklyn Rapid Transit, on 208,000 shares, closed at 72, a gain of 2¼. General Electric, on sales of only 282 shares, was off 1¾ to 122. Metropolitan Street Railway, on fair sales, was off ¼ to 175½, and Manhattan for the week declined 1½ to 95. In Boston, American Bell Telephone closed 341-343; Erie, 107½; Michigan, 100-102; New England, 135 bid; Mexican, 3⅛; West End, 93; Boston Elevated, 98¾; Massachusetts Electric Railways preferred, 75; Westinghouse Electric, 41 common, 62 preferred. In Chicago, Metropolitan Elevated preferred sold 74½-77; West Chicago, 110½; South Side Elevated, 101. In Philadelphia, Electric Storage Battery sold 78-78¼ common, 85-85½ preferred; Philadelphia Electric, 5⅝-6; American Railways, 5¼-5⅜; Philadelphia Traction, 96-96¼; Union Traction, 39⅛-39¼; Pennsylvania Electric Vehicle, 7⅜-7½ common, 3½-3⅝ preferred. In the New York outside market, Electric Axle Light & Power closed at 5-5½; Electric Vehicle, 65-70 common, 90-95 preferred; Electric Boat common, 24-27, preferred 39-42; General Carriage, 7⅜-8; New York Electric Vehicle Transportation, 11¾-12½; New England, 6½-7; Illinois, 5¼-5⅝.

HUDSON RIVER WATER POWER.—Announcement is made of the purchase by the Hudson River Water Power Company of all the land for four and one-half miles on both sides of the Hudson River, beginning some five miles below Glens Falls, N. Y., where water power of 10,000-hp is developed, and at the point where the newly purchased lands begin another 10,000 horse are available. The company has also bought the Saratoga Gas, Electric Light & Power Company, with net earnings of $40,456 per annum. It is proposed to issue $750,000 5 per cent. 30-year gold bonds to pay for the two properties, and for the construction of a 72-foot dam and power and transmission plant. These bonds will be offered at 101 and interest. The total issue is limited to $1,500,000.

TELEPHONE SUBSCRIPTION.—The directors of the New York & New Jersey Telephone Company, sub-company of the American Bell Telephone Company, have voted to offer to the stockholders $1,500,000 (15,000 shares) of unissued stock of the company. Each stockholder of record December 28 is entitled to take one new share for every four shares of present stock. The right to subscribe expires 3 p. m. February 1. Payment is to be made as follows: Twenty-five per cent. February 1, 25 per cent. May 1, 25 per cent. August 1, and 25 per cent. November 1. The company kas one of the best territories in the field. Its new Brooklyn exchange headquarters was illustrated and described in these pages December 23.

CHICAGO METROPOLITAN.—The Chicago Metropolitan Elevated statement, July 1 to December 31, 1899, is: Gross earnings, $624,158; operating expenses, $270,717; surplus, $353,440; interest, $2385, making total credit $355,825; bond interest and charges, $157,620; taxes, $25,105; rentals, special accounts, $74,022, leaving balance to income account $256,747. December estimated makes total credit to income account for six months $144,078; gross increase, 23.68 per cent.; operating expenses increased 10.37 per cent.; surplus earnings increased 36.33 per cent.; daily average gain in traffic, 22.37 per cent. The stockholders have re-elected the following directors for three years: C. F. Dietrich, J. P. Wilson, W. W. Gurley.

CAR LIGHTING.—A special despatch from Trenton, N. J., of Jan. 8 says: With a capital of $16,000,000 the Consolidated Railway Electric Light & Equipment Company was incorporated yesterday. The company is empowered to make use of electric light and power and also to manufacture gas. The incorporators are William W. White, New York; Frank C. Rowley, Brooklyn, and Walter C. Butler, West Orange. The object of the company is to combine the various concerns now engaged in the electric and gas lighting of steam and electric cars. In time it is understood that the Pintsch Light Company will become part of the new combination.

GENERAL CARRIAGE.—The control of the General Carriage Company has been obtained by Cyrus Field Judson, of New York, and Joseph Leiter, Chicago. An entirely new board of directors has been elected, consisting of Cyrus Field Judson, president; Winfield S. Jewell, vice-president; Frank W. Curtis, secretary and treasurer, all of New York; Joseph Leiter, Chicago; Robert I. McKinstry, Camden, N. J. It is stated that this board will shortly be increased, and other important interests will be represented in the directory. Edwin Gould is said to have become a large stockholder in the reorganized General Carriage Company.

CONSOLIDATED GAS.—A meeting of the Gas & Electric Light, Heat & Power Company was held this week in the office of Anthony N. Brady. The following gentlemen were elected directors: Anthony N. Brady, N. F. Brady, Thomas E. Murray, W. E. Dwight, H. E. Gawtry, W. G. Bogert and R. G. Ballentine. At a subsequent meeting of the board A. N. Brady was elected president, N. F. Brady, vice-president, and Louis B. Gawtry, secretary. It will be seen that the new officers represent both the electrical and the Consolidated Gas interests. Details of the combination will be found elsewhere in this issue.

ATTACKING WESTERN UNION.—An anonymous circular respecting Western Union, charging that the directors were paying unearned dividends, was sent to a number of Wall street houses last week. The street took it to signify that the circular came from some shorts who were anxious to depress prices in order to cover, and as a consequence instead of a recession in the quotation a gain of 1⅜ points on sales approximating 4500 shares was scored. The charges in the letter were pronounced by directors of the company to be wholly untrue. There is too much of this mean, dirty business.

RAILWAYS COMPANY GENERAL.—Important developments in connection with the Railways Company General are likely to take place at no very distant date. The most significant of these seem to lie in a trunk line trolley road connecting Philadelphia and New York and tapping some of the more promising suburban districts and small towns which lie between. At least a portion of the Old York road will be utilized, but just what connections the line is likely to make cannot at present be fully set forth.

THE STANLEY COMPANY.—The Stanley Electrical Manufacturing Company was incorporated last week in New Jersey to make and deal in dynamos, etc. Frank O. Briggs, William H. Gandy, Duncan Anderson, William Anderson, John Janeway, Louis H. Taylor, William Taylor, all connected with the John A. Roebling Sons' Company, of Trenton, are corporators. The capital is $2,000,000. Important developments may be looked for any minute.

IMPERIAL, ST. LOUIS.—The Imperial Electric Light, Heat & Power Company, of St. Louis, has passed into the hands of J. G. White & Co. and their friends, who will develop it with wonted skill and success. The plant embodies the Arnold system, with Siemens-Halske apparatus, and was described recently in these columns. Bryan & Humphrey, of St. Louis, are the consulting and supervising engineers.

DIVIDENDS.—The New York & New Jersey Telephone Company has declared a quarterly dividend of 1½ per cent. and an extra dividend of 1 per cent., payable January 15, to stock of record January 5. The National Gramophone Corporation has declared the usual monthly dividend of 1 per cent., payable January 16. Books close January 6 to 16 inclusive.

NEW YORK METROPOLITAN.—The official report of the Metropolitan Street Railroad of operations for December shows in the gross income for the month an increase of $164,389 over the corresponding month of last year. During the six months ending with December there was an increase in gross earnings of $948,067.

ERIE TELEPHONE.—The Erie Telegraph & Telephone Company will offer this week to its stockholders the privilege of subscribing for 20,000 shares of new treasury stock at par, subscriptions to be made on or before January 29 and payment before February 14.

NEW YORK CORPORATIONS.—The secretary of state for New York notes that last year 49 gas and electric companies were incorporated in this State, with a capital of $7,891,000, and 40 telegraph and telephone companies, with a capital of $2,437,200.

DISTRICT TELEGRAPHS.—A special despatch from Columbus, O., says: The American District Telegraph Company has sold out to a company which is acquiring District Telegraph property in several cities.

Commercial Intelligence.

THE WEEK IN TRADE has been quiet in the sense that the holidays have been succeeded by a period of stock taking, still in process. But there is much strength and hopefulness underlying the reserve of force, and in various quarters the belief is openly expressed that 1900 is going to be a better year than its predecessor. It is pointed out that with any sign of a lowering of price, an immense range of new orders come into sight, pressing for satisfaction, and that a good part of such business is export. Another feature is the fact that England's demand for material in the Transvaal war is just now beginning to make itself felt in a wide area of consumption, stimulating both production and prices. In the electrical field both here and in Europe the demand is strong for all classes of apparatus, and there is not the first sign of any let up. We heard of one instance this week where a large electrical concern ordering a certain quantity of metal requested the tender to be made on the basis of four times as much as it had previously required at any one time—and the previous orders had not been small A good deal of preparation is being made in all lines that open up with the spring, and reports come in of a large amount of street railway work to be done. The fan motor trade is also getting ready for a good season. Discussing the general situation, Dun's reports say: Most people in business have been so occupied with the accounts and the settlements of the past year that little new business has yet been done. No new tendency in manufacturing or in trading appears, and less change than was anticipated in money markets. The street seems to have promptly applied to the uplifting of stocks most of the $2,750,000 net receipts from the interior, and the $1,000,000 daily deposited with banks by the treasury, the proportion of commercial loans reported by banks being 16 per cent., against 18 per cent. last week, but as yet the demand is but moderate. Funds received in January settlements may be less largely invested in securities than some expected, because the extreme low prices reached late in December induced such investments in stocks in advance, while the great rise since has been so rapid as to cause hesitation. Failures in 1899 were 9393 in number, with liabilities of $123,132,679. The last days of the year added a few to the number, and some millions to the known liabilities of firms and banks which failed close to the end, so that commercial defaults reached $90,879,889, of which $30,792,164 were in manufacturing, $48,924,771 in trading and $11,162,954 in brokerage, promoting and other commercial liabilities. Yet it remains true that the failures of 1899 were in amount smaller than in any other year of the past twenty-five excepting 1880 and 1881. The failures for $100,000 or more in the past six years have ranged between $31,522,186 in 1899, and $98,503,932 in 1896, the decrease being more than two-thirds, but the small failures ranged between $59,356,703 in 1899, and $127,592,902 in 1896, the decrease being more than one-half. For the month of December the gross earnings of 49 railroads show a gain of 7.21 per cent. over the large returns of last year.

AMERICAN ELECTRIC VEHICLE COMPANY.—This Western concern, as already intimated, has undergone an important change of base in coming to New York, where new interests assume a prominent part, reinforcing the work of the old managers and officials. Mr. J. Herbert Ballantine, of Newark, N. J.; Mr. George T. Lister, of the North Hudson Railroad Company; Mr. Myles Tierney, president of the Hudson Trust Company, and Mr. George B. Hurst, of the Waldorf, purchased the patents and assets of the American Electric Vehicle Company of Illinois, likewise a number of other patents, among them some very valuable ones on storage batteries made by the Planté process. On December 29 the American Electric Vehicle Company was organized by the above-named gentlemen under the laws of New Jersey, with a capitalization of $5,000,000. The officers of the company are J. Herbert Ballantine, president; C. E. Corrigan, vice-president and general manager; George T. Lister, secretary and treasurer. The board of directors consists of these three officers and Messrs. Percy Ballantine, Myles Tierney, George B. Hurst, H. G. Osburn, the electrical engineer; John B. Adams and Henry Young, Jr. The factory is located temporarily in Hoboken, N. J., pending the construction of a large plant in Newark, N. J., work upon which will commence immediately. The present capacity is five finished vehicles per day. The American Electric Vehicle Company have always built a good serviceable automobile at a very moderate price, and they propose to go ahead with their present large capital to develop their business and keep up their reputation. A New York office, with repository and general salesrooms, will soon be opened in this city, in connection with which will be a plant for recharging batteries for their patrons.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended January 6: Athens—3 cases electrical material, $26. Amsterdam—3 cases electrical material, $85. British Australia—5 packages electrical machinery, $648. Canada—8 cases electrical material, $56. Florence—24 packages electrical material, $613. Havre—104 packages electrical material, $2072. Hayti—10 packages electrical material, $60. Hamburg—95 packages electrical machinery, $1675. Liverpool—3 packages electrical cranes, $1200. London—102 packages electrical material, $4449; 11 electrical machines, $1242. Rotterdam—7 cases electrical material, $75. Stettin—1 case electrical machinery, $151. Southampton—4 cases electrical machinery, $160. St. Petersburg—1 case electrical material, $154. Santo Domingo—35 cases electrical material, $3544. Uruguay—13 cases electrical material, $150. United States of Colombia—16 cases electrical material, $141.

GREGORY ELECTRIC COMPANY, of South Clinton street, Chicago, inform us that they have just completed their inventory and have shown a phenomenal increase for the year, with orders unabated, as to which their January bargain sheet is an indication. Among recent sales they record one 125 Wood arc lighter to the Standard Electric Company, of Danville, Pa.; one 100-kw generator 500 volts to the Ashley Falls (Mass.) Marble Company; one 3000 light Westinghouse alternator to the Oshkosh (Wis.) Light & Power Company; another 3000 light Westinghouse alternator to the City Railway Company, Rome, Ga.; a third 3000 light Westinghouse alternator to the Superior Electric Light & Power Company, West Superior, Wis.; and a fourth of the same size and same make to the Cynthiana (Ky.) Electric Company. There are a number of smaller orders, presenting a formidable output of current in the aggregate.

SPRAGUE ELECTRIC COMPANY, 527 West Thirty-fourth street, New York, report having closed contract with the Government authorities for a plant for the United States Naval Academy, Annapolis, Md. It will comprise 24 50-kw generators direct connected to Ball & Wood engines, and is designed to make a handsome, compact, flexible installation. The Sprague Company report that they are getting ready briskly for a large fan motor trade and will put three sizes on the market this season—12-inch at 1800 revolutions, 15-inch at 1500 and 18-inch at 1300. All these models for 1900 will be of the popular and successful Lundell style, but will have an improved guard.

THE TROLLEY IN SIAM.—Speaking of the Short trolley system put in some time ago in Siam, Mr. Hamilton King, the Consul General there, under date of November 2, writes: A private syndicate in 1887 obtained a concession for street railway lines in Bangkok. These were built for horse cars in 1889 and changed to an electric trolley system in 1892. This line is crowded with passengers all day long and pays 12 per cent. on the investment. The rolling stock, machinery and wire for this road have all been bought in America, the rails in Europe. It is probable that this line will be extended in the near future, and that another similar system will be built.

THE CLING-SURFACE MANUFACTURING COMPANY, of Buffalo, N. Y., reports business steadily increasing with repeated orders from old customers, as well as new orders. They have just established a branch office in New York City at 253 Broadway. Among orders of last few days are those from the Edison Illuminating Company, Easton Pa.; New York Central & Hudson River Railroad; Lonaconing Electric Light & Power Company, Lonaconing, Md.; Mt. Vernon Electric Light, Power & Water Company, Mt. Vernon, Wash.; Erie Railroad Company and others.

COPPER ABROAD.—Mr. Jesse Lewisohn, who has just returned from Europe, says that the demand for copper in Europe is excellent. In France the consumption of copper has increased over 75 per cent. in two years. The French government is now preparing for the construction of telephone lines that will require over 25,000,000 pounds of copper. Orders have recently been placed in Germany for the construction of a large number of locomotives, in which 5000 tons of copper will be required.

THE TROLLEY ABROAD.—As already intimated in this department, the London County Council has decided to install an underground electric trolley system after American plans and using American cars. The cost will be $15,000,000, and the fares 2 and 3 cents. It is understood that the work will be begun during the present century—no, we mean the next.

TRANSPORTATION MATERIAL.—A thousand tons of steel trolley rails, each 45 feet long and weighing 1300 pounds, were shipped to Rotterdam on the British steamship Ping Suey, which sailed from Girard Point, Philadelphia, last week. The rails are to be used in equipping an electric railroad to be built in Holland on the American plan.

LAKE COPPER.—Some idea of the increase in the output of Lake copper may be formed from the fact that there passed through the lakes, via St. Mary's Falls Canal, in 1869, 18,662 tons; in 1879, 22,309 tons; in 1889, 33,466 tons, and in 1899, 120,090 tons.

Special Correspondence.

NEW YORK NOTES.

New York, Jan. 9, 1900.

MR. H. C. HOLFINGHOFF, of the Bickford Drill & Tool Company, was in New York last week. The company's plant in Cincinnati is still being taxed to its utmost to meet the demands made upon it for the well known Bickford radial drills.

AUTOMOBILE PERMIT FOR A WOMAN.—Miss Florence E. Woods, of this city, has been granted a permit to run an automobile runabout through Central Park. Miss Woods has the distinction of being the first woman to receive such a permit. She is an expert automobilist, and is said to be only about 17 years of age.

MR. CHAS. F. CHASE, Eastern manager for the Cling-Surface Manufacturing Company, has opened an office in the Postal Telegraph Building, 253 Broadway, New York, where he will take care of the trade of the Atlantic Coast, Eastern Canada and the Provinces. Mr. C. V. Bitter will act as New York agent for Mr. Chas. F. Chase.

WARREN-MEDBERY COMPANY.—Judge Stover, of Amsterdam, N. Y., has appointed Mr. G. M. Ingalsbee, of Sandy Hill, temporary receiver of the Warren-Medbery Company, builders of dynamos, etc. Directors Carpenter and Cunningham petitioned that Judge Ingalsbee be named. Mr. H. J. Medbery informs us that he withdrew from the company about a year ago and has had no connection with it since.

MR. FRED A. GEIER, secretary and treasurer of the Cincinnati Milling Machine Company, paid a flying visit to New York last week. The business of this company continues its phenomenal growth. It has a wonderful record, founded upon the merit of its product; probably no machine tool made in the City of Cincinnati has done more to give that city its present reputation for good machine tool building than the Cincinnati miller built by this company.

MR. C. T. JAEGER, formerly lamp maker with the American Endoscopic Company, Providence, R. I., has become superintendent for the American Miniature & Decorative Lamp Company, New York City. This company has been quite fortunate in securing the services of Mr. C. T. Jaeger, and the change will also relieve his brother, Mr. H. J. Jaeger, of considerable undue pressure in his work. The qualities of Jaeger lamps are well known, and the demands have compelled the company to increase its facilities at once. In the very near future prompt shipments will be assured.

ELECTRIC STAGE.—A trial trip of an electrically propelled stage was made on Wednesday last from the stables of the Fifth Avenue Coach Company, on Eighty-eighth Street, along Fifth Avenue to Washington Square and return. The stage is owned by the Columbia & Electric Vehicle Company, of Hartford. There is one seat on the outside, above and behind that of the driver, broad enough to accommodate three persons. The inside is finished in oak and will seat eight persons. The stage is equipped with four inside roof lights, two outside lights, one on either side of the driver's seat, and one portable emergency light, all electric. The storage battery of 22 cells, which propels the vehicle, weighs 1500 pounds and the total weight of the vehicle is 5500 pounds. The front wheels are a little less than 3 feet in diameter and the rear wheels a little more than three feet. The maximum speed is nine miles an hour. This is the first step toward substituting automobile stages on the Fifth Avenue line for the present lumbering horse vehicles, which are little better than curiosities of antiquity. An illustration of the stage above-mentioned was given in these columns in a recent issue. The vehicles which will be adopted will be larger than the one shown in that illustration.

SEARCHLIGHTS FOR THE FIRE DEPARTMENT.—A builder's trial was given last Wednesday night of the new searchlight apparatus built for the New York (Manhattan) fire department. The machine is provided with two searchlights. One of them was fitted with a lens for dispersing its rays into a long parallelogram. When the light from this was projected upon the front of a building it lit up the whole face of the structure from the ground to the fourth or fifth story, bringing into sight every detail of the structure. The second searchlight was fitted with only a plain glass and its rays cast a brilliant small circle of light upon its object. The purpose of this is to light the interior of buildings and it has proved its ability to do this to the satisfaction of all who saw it work. The two searchlights are both detachable from the machine and coils of insulated cable, each 200 feet long, are provided on two reels, which will make it possible for the lights to be carried to any place near the machine where they may be the most useful. The body of the machine is the same as that used in the smallest class of engines now furnished to the fire department. Instead of the engines and pumps for projecting a stream of water, a dynamo and the engine to drive it are provided, and the two searchlights are mounted one on each side of the front of the upper part of the engine just behind the driver's seat. The searchlights and electrical equipments were furnished by the Bullock Company, of this city. The lights are exactly the same as those made for the United States navy, and are made so that their rays can be projected to any point around the machine. Each is of 8000-cp and the reflector is 18 inches in diameter. The machine weighs 6500 pounds, and cost between $5000 and $6000. The test is said to have been satisfactory to the fire department. It is thought that these searchlights will form a valuable addition to the fire-fighting equipment of the city.

MOTOR VEHICLES and accessories will be exhibited at the Automobile Show to be held in Madison Square Garden, New York, during the week following January 20, in conjunction with the big cycle show, and great interest is manifested in this first opportunity to view the various makes under one roof. The largest exhibitor will be the Riker Electric Vehicle Company, of Elizabethport, N. J., who have contracted for twelve spaces, and will show a complete line of their very complete product. The Duryea Motor Company, the Indiana Automobile, the Oakman and the Loomis Automobile Company are among the self-propelled vehicles that will be shown. The move to combine the automobiles with the bicycles has proved to be an excellent one, but there are those who predict that the time is not very distant whn the bicycle can consider itself lucky to have a share of the space at an automobile exposition. For the benefit of exhibitors, it might be stated that when sending goods to the show they must be marked with the name of the consignor and the number of the space, addressed to the Madison Square Garden, New York City, and will be received only at the Fourth Avenue and Twenty-seventh Street entrance, where a receiving clerk will take charge and send a printed notice of the arrival of the goods to the space for which they are marked. Charges of all kind must be prepaid. The show will be opened from 10 a. m. until 10:30 p. m. each day from Saturday, Jan. 20, to the following Saturday, exclusive of Sunday. Storage for goods can be secured in the Exhibition Hall. Of course, there will be all the other privileges which Manager Frank W. Sanger, of the National Cycle Exhibition Company, has always afforded exhibitors at cycle shows. With each rented space there is given five coupon books containing four admissions for each day of the exhibition, being equal to 140 admissions for the entire period of the show. These admissions are good for exhibitors and gentlemen only, and are to replace the exhibitors' buttons formerly used. Special tickets, if required, will be issued for ladies. Any regular qualified bicycle or automobile agent, manufacturer, exhibitor or employee of exhibitor will be admitted to the Garden free from 9 a. m. to 1 p. m. by giving his name and address at the Bureau of Information when entering.

Buffalo, N. Y., Jan. 8, 1900.

THE WOODS MOTOR COMPANY, of Chicago, has been making an exhibit in Buffalo of its various types of electrical vehicles and is thinking seriously of establishing its manufacturing plant along the Niagara frontier at some point. A Buffalo Electric Vehicle Transportation Company has also been organized to use the Woods electric vehicles, and a close competition is expected with the New York Electric Vehicle Transportation Company, which uses the Columbia type of outfit. The Pan-American Exposition being in view, there is no doubt the development of the automobile industry in Western New York will be very rapid. The Woods vehicles are being charged by Niagara current, and the New York Transportation Company will without doubt use current from the Buffalo General Electric Company or the Cataract & Conduit Company, while the Columbia electric vehicles have established a plant of their own for charging, as described above. It therefore looks as if the Buffalo branch of the New York Vehicle Transportation Company meant to be independent of the Niagara power transmission as far as supplying current to their automobiles is concerned.

ELECTRIC VEHICLES IN BUFFALO.—The Buffalo branch of the New York Electric Vehicle Transportation Company opened its station at 240 West Utica Street Dec. 18. The building has a macadamized floor space of 22,000 feet, and has installed therein at present nine vehicles of various styles. It is equipped with an engine and dynamo room and offices, and is ready to do business in Buffalo. Dr. Truman T. Martin is manager for Western New York. The new automobile station has at present two broughams, two hansoms, a five-passenger surrey, a phaeton and a 14-passenger omnibus. The dynamo room is equipped with a 40-hp Ruger gas engine and a Westinghouse generator for charging the storage batteries of the various vehicles. It is intended to increase the charging plant as more vehicles are added. The repair shop has a floor space 40x100 feet. The largest room is 100x200 feet and is at present used for instructing the new operators who are to run the carriages. Mr. David Sowers, of Hartford, Conn., is superintendent of the electrical and mechanical departments, and is thoroughly conversant with the work, having previously been with the Pope Company before the consolidation. The new omnibus, it is understood, will run a transit service from Seneca Street, through Main and Chippewa Streets and Delaware Avenue, to Chapin Place and return.

NEW ENGLAND NOTES.

Boston, Mass., Jan. 8, 1900.

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—It is stated that the institute is looking for a new site upon which to build because of the limited territory near the present buildings. There is talk of going outside of the city limits, where more space can be obtained.

THE BOSTON ELEVATED RAILWAY issues a pamphlet report for year ended Sept. 30. Operating figures as well as the balance sheet are the same as those filed with the railroad commissioners Nov. 28. Gross earnings were $9,671,440, increase $492,344. Net earnings $2,844,290, increase $231,778. The company has increased the mileage of its leased lines by building over 26 miles of track, and has purchased or built 50 box and 100 open cars to operate thereon. The most important addition to the equipment is the new engine and generator at the central power station, which, although not yet completed, is well under way. Passengers carried during the year, 191,023,224, an increase of 9,701,929, or 5 1-3 per cent. Free transfer passengers carried, 42,113,715, an increase of 13,873,835, or over 49 per cent. Contracts for generators have been made with the Westinghouse and General Electric Companies.

PENNSYLVANIA AND OHIO NOTES.

Pittsburg, Pa., Jan. 6, 1900.

MR. A. F. COLLINS, of Philadelphia, was here last week and gave a lecture on wireless telegraphy before the electrical students of the Y. M. C. A. of this city.

MR. CHARLES S. COOK, the manager of the Pittsburg agency of the Westinghouse Electric & Manufacturing Company, returned last Monday from a week's trip to New England, where he had been to spend the holidays with some friends.

THE CARNEGIE STEEL COMPANY has installed a number of electric hoists to unload coal from the boats at the Homestead mills, near this city.

WEATHER SHIELDS FOR CARS.—General Superintendent John Murphy, of the United Traction Company, has issued orders to have shields placed on the sides of the doors of all traction cars so as to prevent the motormen from being too much exposed to the cold.

IKUZO OOKA, and his private secretary, H. Hoski, of Tokyo, Japan, were in the city yesterday visiting the Westinghouse Electric works at East Pittsburg. Mr. Ooka is greatly interested in a number of electrical enterprises in his native land, and he is also the proprietor of a Japanese newspaper.

AFTER A STRUGGLE of five years the West End Traction Company, of this city, has at last received the concession from the County Commissioners to construct a loop for the completion of its line at McKees Rocks. This will add great facilities to the company's line when finished. Work is to be commenced at once.

MR. WILLARD WHITE, of Boise, Idaho, manager of the Idaho Power Company, has been a visitor at the Westinghouse works at East Pittsburg. Mr. White said that his company is now installing a power plant on the Payette River, which will give light and power to all the mining plants within a radius of 100 miles.

THE WARREN ELECTRIC & SPECIALTY COMPANY.—At a special meeting of the Warren Electric & Specialty Company, of Warren, Ohio, Mr. T. H. Gillmer was elected president, C. H. Angstadt, vice-president, and E. M. Gillmer, secretary and treasurer. The company also voted to double its capital stock from $100,000 to $200,000.

THE CREIGHTON, NEW KENSINGTON & SPRINGDALE ELECTRIC STREET RAILWAY, of New Kensington, Pa., began the construction of its lines recently. This road will extend so as to eventually connect with an electric line running into the city of Pittsburg, which will make a direct electric road of 25 miles. Mr. John Guffey and Frank Peffer, of New Kensington, are interested in the road.

CONSOLIDATION OF ELECTRIC LIGHT COMPANIES.—The electric light companies of McKees Rocks and the city of Carnegie have completed arrangements of consolidation and both plants when merged into one will light up the towns of Ingram, Crafton, Idlewood, McKees Rocks and Carnegie. William Stetler will be electrician and superintendent, while Ernest Gothrop will be superintendent of construction.

Cleveland, Ohio, Jan. 6, 1900.

THE ROYAL INCANDESCENT LAMP COMPANY, Cleveland, has taken up new quarters in the new Stone building, No. 28 Lake street.

THE NATIONAL CARBON COMPANY is preparing to increase the capacity of its plant at Ravenna and will erect an addition 100x85 feet.

THE OHIO CENTRAL TRACTION COMPANY is making surveys with the intention of extending its line from Galion to Crestline; also from Bucyrus to Upper Sandusky.

ELECTRIC LIGHT FOR GIRARD.—The town of Girard has contracted with the Youngstown Electric Company to furnish it arc lights at a rate of $66 per year, a reduction of $4 per year from former price. The contract is for five years.

THE CLEVELAND ARMATURE WORKS reports that its book, "Practical Electricity, with Questions and Answers," which was brought out a few months ago, is meeting with remarkable demand. A second edition will be ordered in the near future.

MUNICIPAL PLANT.—The village of Collinwood, near Cleveland, has decided to equip an electric lighting plant of its own, and $60,000 has been appropriated for this purpose. At present the village has 63 arc lights, current being furnished by the Cleveland Electric Illuminating Company.

DIVIDEND.—On Jan. 1 the Cleveland Electric Railway Company declared a dividend of three-fourths of 1 per cent., the first since the strike of last year. The gross earnings of the company for December were $164,000, or a gain of $11,000 over the same month of the previous year, showing that the effects of the strike have entirely passed away.

INCREASE OF TELEPHONE CAPITAL.—At a meeting of the Warren-Niles Telephone Company held a few days ago the capital stock was increased from $25,000 to $100,000, and the following officers were elected: W Hyde, president; Jules Vautrot, Jr., vice-president; E. J. Clapp, secretary, treasurer and manager. A quarterly dividend of 2½ per cent. was declared.

WIRELESS TELEGRAPHY.—Prof. Dayton C. Miller, of Case School of Applied Science, read a paper on wireless telegraphy before the members of the Cleveland Electric Club last Wednesday evening. He illustrated the paper with experiments. Much of the evening was devoted in explaining the system which Marconi perfected and his experiments were made with apparatus patterned after Marconi's.

THE CENTRAL CONSTRUCTION COMPANY, of Wauseon, a company controlling a number of the independent lines in Ohio, has incorporated the Elkhart Telephone Company of Indiana, with a capital stock of $100,000. E. L. Barber, of Wauseon, is president of the new company. The Indiana Company will operate an exchange connecting with the independent system of lines maintained in Ohio and Michigan.

THE BAKER MOTOR VEHICLE COMPANY is the title of a new company headed by Walter Baker of the American Ball Bearings Company, of Cleveland, which is preparing to go into the manufacture of electric carriages on quite an extensive basis. A factory is being erected and a large order for machinery equipment has been placed with a local company. Mr. Baker has long been an electric vehicle enthusiast, having already built several machines for experimental purposes.

INTERURBAN RAILWAY INTERESTS.—A conference of gentlemen interested in the interurban electric railways of the state was held in Columbus last Thursday and as a result another meeting will be called next month to form a state association for the protection and promotion of the interests of interurban roads. The Interurban Company, it is said, expect a bitter fight with the street railway corporations of large cities, especially where entrance to such cities is sought, and they believe they can best meet this opposition by pooling their interests.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, through its Cleveland branch office, has recently secured the contract for the electrical equipment for a new lighting plant for the Lake Erie Electric Light Company, of Lorain, which is to furnish light for the city. The installation consists of two 150-kw single-phase direct connected alternators. The power is furnished by a Harrisburg Ideal 225-hp engine. The arc lights used are of the alternating current constant current type, with the Manhattan system of regulators. The Westinghouse Company has lately equipped a plant for the Cleveland Tanning Company, of this city, said to be the first concern of the kind to adopt electric power. It consists of a 60-kw generator and five motors aggregating 100-hp.

Cincinnati, Ohio, Jan. 6, 1900.

MANAGER LAWRENCE, of the Standard Electric Company, reports the plant busy getting out orders placed during the old year, and inquiry good for the new.

PRESIDENT GEORGE BULLOCK, of the Bullock Electric Manufacturing Company, has been enjoying a period of rest at his home in Norwood during the post holiday season.

THE LAWTON-BEATTIE COMPANY has on hand the furnishing of a number of electric lighting plants for local business houses. They will put in a 250 or 300 light plant for the P. Sullivan Shoe Company during the coming week.

THE STEWART ELECTRIC COMPANY a few days ago shipped to a prominent city in North Carolina a finished generator, 100-kw Edison type, to be used on an electric street railway line. The Stewart people also finished the switchboard.

MR. JACOBS, of the Triumph Electric Company, reports business keeping up surprisingly well. In response to a recent telegram orders from Harrisburg, Pa., and New York City machines were shipped there early this week. The company is getting out a handsome new catalogue, and is also getting out a new bulletin on belted generators.

CAPTAIN WM. MAYO VENABLE, electrician of the Cincinnati Board of Underwriters, has accepted a position with the National Construction Company. Mr. Venable's successor is L. G. Lilley, who has been with the board in the same capacity some five or six years, returning to the service from a post with A. G. Schulman, the contractor.

THE AMERICAN LONG DISTANCE TELEPHONE COMPANY will establish an extensive exchange here. Two large rooms in Third Street have been rented and the equipment is being installed. The company has been operating at Third and Lawrence in a comparatively limited way, and increased business necessitated enlargement of capacity.

EDISON COMPANY'S NEW MANAGER.—Mr. W. F. White, of Omaha, is the new general manager of the Edison Electric Company, succeeding Mr. John I. Beggs, who goes to Milwaukee to take personal charge of a number of electric properties in which he is interested. Mr. Beggs made a great record in Cincinnati at the head of the Edison Company, and all public spirited citizens are loath to see him go, but will give Mr. White, his successor, a hearty welcome.

PRESIDENT JANTZ, of the Jantz & Leist Company, appears in an amiable frame of mind, and notes that his firm has been busy right through the holidays, with orders ahead almost up to June. He, in common with other large manufacturers here, reports that prices on dynamos and motors have gone up fully 25 per cent., and confidently expects better prices to rule during next year. The heavy business of the past three months has tested the capacity of the Jantz & Leist Company.

THE LITIGATION now in the Supreme Court of Ohio to aid the consolidation of the Cincinnati & Hamilton Electric Street Railway and the Cincinnati & Miami Valley Traction road into a through line from Cincinnati to Dayton has been compromised. The termini of the roads are three blocks apart and the connecting strip of track, owned by the Hamilton & Lindenwald Electric Transit Company, has been leased for 16 years to the interurban roads. The consideration in the lease is said to be $10,000 a year.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY received during the week another order from the Manchester *Sporting Chronicle*, Manchester, England, for seven teaser equipments for operating printing presses. The Bullock Company reports inquiries from abroad to be increasing and sales likewise, both in number and amount. A cable order was received a few days ago from Paris from the company's representative there asking for a 300-kw engine type machine for railway purposes. This is the third order for the same concern, the other two machines being 800-kw each. The company is putting out a very handsome little monthly calendar.

WESTERN NOTES.

Chicago, Ill., Jan. 6, 1900.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, of Madison, has begun the New Year by opening a suite of offices at 939-941 Monadnock Block, under the management of Mr. O. W. Bruner, assisted by a staff of competent engineers, thoroughly experienced in the line of work which has been so successfully promoted by this company. The Chicago department is a branch of the factory office, an outgrowth of a rapidly increasing trade, and is solely for the purposes of facilitating prompt and direct dealings between the factory and its customers.

RESIGNATION.—Mr. James E. Keelyn, president of the Western Telephone Construction Company, has tendered his resignation because of ill-health, which forbids his continuing work. Secretary Hamburger, of the company, states that the resignation was received and accepted with the greatest regret by the directors. He stated that his company is as strong as ever in opposition to a plan of consolidation of independent telephone companies. "We have," he said, "received many overtures, especially in the past few weeks, to join in the movement to consolidate all the companies outside of the Bell Company into a single opposition telephone concern to control the outside exchanges. If the movement is successful we shall be independent of two combinations instead of one."

THE NORTHWESTERN ELEVATED.—The trouble between the city and the Northwestern Elevated road came to an end for the time being on Jan. 3, when, after a conference of six hours, representatives of the company, the financial backers of the enterprise and officials of the city agreed upon an ordinance presented to the city council. The ordinance grants an extension of time to May 31 for the road from Wilson Avenue to Lake Street, and to May 1 from Montrose Boulevard to Lake Street, for which the company forfeits its deposit of $100,000 and various concessions granted it under the original ordinances. All the cases against employees of the road for attempting to run trains contrary to the orders of the police department will be dropped. An attempt was made to run a train on Jan. 3, but about 50 officers stood on the track in front of it, and others climbed aboard to arrest the motorman the instant he placed his hand on the lever. The attempt was abandoned. No trains will be run until the final completion of the road.

Milwaukee, Wis., Jan. 5, 1900.

MR. H. A. BRINKERHOFF, manager of the La Crosse Telephone Company, has resigned on account of ill-health.

WIRELESS TELEGRAPHY.—It is stated that the Ann Arbor Railway has closed a contract with the Marconi people for a system of wireless telegraphy from Menominee to Frankfort.

THE WISCONSIN TELEPHONE COMPANY has again been refused a franchise by the city of Sheboygan. At a meeting of the council the committee to whom was referred the petition for certain privileges reported adversely. The report was accepted.

RAILWAY SURVEY COMPLETED.—It is stated that surveys have been completed for the Mineral Point & Northern Electric Railway from Mineral Point to Highland, about 23 miles. Grading will be started in the spring. Richard Kennedy, of Highland, and Charles W. McIlhon, of Mineral Point, represent the company.

MR. E O. HUMPHERY, of Chicago, who is trying to interest Milwaukee capital in a proposition to build an elevated electric railway from Milwaukee to Chicago, is still at work on the project. It is an old scheme that has been brought forward at various times in the last 10 years. It is proposed to use the Cook system by which the cars will be suspended between two tracks, one at the top and the other at the bottom of the car.

GEORGE W. KUEMMERLEIN, for several years superintendent of transportation of the Milwaukee Electric Railway & Light Company, has entered upon his new duties as superintendent of the Belle City line at Racine. M. Austin, the former superintendent at Racine, has come to Milwaukee to take a position in the transportation department. W. H. Greenslade has been appointed superintendent to succeed Mr. Kuemmerlein.

Indianapolis, Ind., Jan. 6, 1900.

UNION TRACTION COMPANY'S PAY ROLL. The pay roll of the Union Traction Company, the largest electric corporation in the state, amounts to over $9000 weekly. The paying office is at Anderson.

MARION SECURES ANOTHER ROAD.—Marion has been selected as the terminus of an electric line from Dayton, Ohio, through Greenville, Fort Recovery, Winchester, New Corydon, Geneva, Linn Grove, Bluffton to Marion.

THE COMMERCIAL CLUB, at Richmond, Ind., has taken steps toward encouraging interurban electric lines to enter the city. The club will aid the line known as the Dayton (Ohio) & Eaton line to extend the same to Richmond.

COPPER WIRE THIEVES.—Copper wire thieves are making much trouble for the elephone and telegraph companies throughout Indiana. The managers say that there is evidently an organized gang of wire thieves. The largest theft yet reported was that of five miles of wire taken off the poles of the Postal Telegraph & Cable Company. A coil of 200 pounds is worth a little more than $50. Thieves select the hours between 1 and 2 in the morning when lines are not much in use.

CHEAP ELECTRIC LIGHT.—Samuel B. Rittenhouse, of Liberty Mills, having amassed a fortune in manufacturing wheelbarrows, has completed a plant for lighting the village by electricity. The town has not more than 500 inhabitants, but Mr. Rittenhouse has secured an old milldam to generate his power and the price is so low that every one in the town can use electric light. In addition, he has submitted a proposition to build a line to North Manchester, three miles distant, and to put in a system of cheap electric lighting, if a franchise is granted him.

GREENWOOD WOOD LINE IN OPERATION.—The starting of cars from Greenwood to Indianapolis was attended with much interest. Would-be "first passengers" waited in the cars for hours. The cars are handsome and elegantly furnished and will accommodate 100 passengers. They enter the city over the Shelby Street line and make the loop around the Union Station. The fear of destroying local trade by reason of carrying people to the city at a low rate is gradually dying out. The steam roads look upon their competitors with no friendly attitude, and insist that the law of crossings be complied with—i. e., that all frog crossings shall be made of 60-pound rails.

St. Louis, Mo., Jan. 5, 1900.

THE COLUMBIA INCANDESCENT LAMP COMPANY.—The stockholders of the Columbia Incandescent Lamp Company have elected W. O. Garrison and A. C. Garrison directors of the corporation.

CONSOLIDATION.—The Imperial Electric Light, Heat & Power Company and the Consolidated Electric Company, of St. Louis, filed an official certificate of consolidation Jan. 3, at Jefferson City, under the name of the Imperial Electric Light, Heat & Power Company.

FUNDS FOR A NEW ELECTRIC LIGHT and heating plant and new elevators for the improvement of the Federal Building, St. Louis, have been asked from congress by Secretary of the Treasury Gage. He asks that $25,000 be provided for new boilers and $23,000 for a new elevator equipment.

CURRENT CUT OFF.—The Missouri-Edison Company turned off the incandescent lights in the alleys and public institutions of this city Dec. 31, because of the expiration of contract. In the poorhouse, city hospital, female hospital, jail, city hall and court house candles and kerosene lamps are being used. Some of the institutions are being lit by the authorities at their personal expense. There is no telling when matters will be adjusted.

THE STREET RAILWAY EMPLOYEES' SOCIETY, of St. Louis, was incorporated Jan. 2. The society was organized for benevolent, fraternal-beneficial purposes, and seeks to promote charity and improve general relations between street railway employees and their families. The society will look after its sick and disabled members and the widows and families of deceased members. James R. McAllister is president, Charles L. Snyder, vice-president; Raymond Henache, secretary, and Archie D. St. Clair, treasurer.

CITIZENS' ELECTRIC LIGHT & POWER COMPANY.—This company was organized about three years ago, and incorporated for $1,000,000. The capital has lately been raised to $3,000,000. In addition, $3,000,000 of bonds will be issued, so that it will be really a $6,000,000 corporation. It will soon be in a position to make and sell electricity for lighting, heating and power purposes. The officers are: President, Julius S. Walsh; vice-president, August Zehner; second vice-president, Rolla Wells; secretary, Eugene Beuoist; treasurer, Breck Jones; manager, Hopkins J. Hanford; chief engineer, Charles H. Ledlie. Several sites for the plant are under consideration. One of them is in East St. Louis. The company will use the poles of the Kinloch Telephone Company, as the stockholders are the same men who control that company. Contracts for the plant will be let within a month.

PHOENIX BATTERY COMPANY ASSIGNS.—The Phoenix Battery Company made an assignment last Thursday, Dec. 28, naming John A. Gilliam as assignee. The assets are placed at $25,000; the liabilities are not stated in the deed of assignment, but will be about $18,000. The company has been engaged in the manufacture of electric batteries and appliances. It was organized April 9 last, with a capital stock of $200,000, only partly paid up. Shortly after it began business it brought suit against a New Jersey concern to test its right to use what is known as the Hugden patent for the making of batteries and to secure those who gave the necessary bond it gave a deed of trust for $8000. This suit is still pending, and the company's assets depend in a measure on the issue. The other assets consist of accounts, material and machinery. The assignee will convert the assets into cash as soon as possible.

San Francisco, Cal., Dec. 24, 1899.

THE PEOPLE'S TELEPHONE COMPANY, San Jose, Cal., is no longer an independent concern. The Sunset Telephone & Telegraph Company has absorbed the opposition and has announced a new schedule of rates.

THE STANDARD ELECTRIC COMPANY, of California, which was recently granted a franchise permitting its transmission line to enter Oakland, has accepted the franchise through President Andre Poniatowski and Secretary William Angus.

THE WESTERN UNION TELEGRAPH COMPANY recently purchased from the United States Government the cable line across the Columbia River at Astoria, Ore. Assistant Superintendent McKissick, of the Western Union, has gone to Astoria to arrange the details of operation, etc.

EARTHQUAKE DAMAGES ELECTRIC PLANT.—It is reported that the walls of an electric power house in San Jacinto, Cal., were thrown down by the recent severe earthquake. The disturbance was confined to a comparatively small area of southern California and was probably the result of volcanic action in the neighboring mountains. Earthquake insurance may be taken out on the coming-century power houses in California.

A PROJECTED TRANSMISSION PLANT.—The owners of the La Grange mine, in Tuolumne County, California, are making arrangements to develop 1000-hp from the Tuolumne River and transmit electric power. The Royal Consolidated Mines will be the first to receive current from the new transmission plant. The working head of water will be 220 feet. Mr. Sidney Sprout, electrical engineer, is manager of the La Grange Company.

THE MUTUAL ELECTRIC LIGHT COMPANY, San Francisco, at its recent annual meeting, unanimously re-elected the board of directors, and the board re-elected P. B. Cornwall, president; W. R. Summerhayes, vice president and manager, and James Fisher, secretary. The report of the year's business showed that a profit of $38,555.13 had been made, an increase of 42 per cent. on that of the preceding year. Of this three dividends of 8 cents per share were declared, amounting to $9840, and the remainder was expended in additions to the plant and extensions of lines. The company expects soon to erect an additional electric lighting plant to meet the needs of its growing business.

A THIRD RAIL ROAD.—All the rights of way have been secured and contracts have been let for the building of a three-rail electric line between San Jose, Cal., and Alviso, the distance being seven miles. It is reported that the San Jose & Alviso Electric Railway Company has signed a contract with Prince Poniatowski's Electric Company for current to operate the road. Alviso is at the head of Alviso slough, which forms a channel to San Francisco Bay. Congress has appropriated $48,000 for the improvement of the channel, so that large vessels can reach San Jose's seaport. It is understood that a third rail, to be laid alongside the electric company's tracks, will permit the Santa Fe Railroad to gain access to the bay and to transfer trains to San Francisco, thus giving the San Jose Railroad competition.

SOUTHERN NOTES.

Washington, D. C., Jan. 6, 1900.

FIRE IN A POWER HOUSE.—On the afternoon of Dec. 28 fire wrought considerable damage to the generating apparatus in the power house of the Potomac Electric Light & Power Company, at the corner of Thirty-third and K streets, in this city. The big No. 2 generator was badly damaged by the fire and water used by the firemen to extinguish the fire. The total damage to the plant is said to be about $50,000, of which only $1000 represents the damage to the building. The No. 1 generator was also badly damaged. One of the two alternators suffered from the deluge of water. The lines of railway depending upon this station for their power supply were tied up for a while, but a temporary connection was made with the power house of the Metropolitan road. A portion of Georgetown was lighted from this station.

Richmond, Va., Jan. 6, 1900.

THE BELL TELEPHONE COMPANY IN RICHMOND.—United States Circuit Judge Nathan Goff has rendered an opinion in which he takes the ground that if the Southern Bell Telephone & Telegraph Company, as decided by the United States Supreme Court, has no right in the streets of Richmond, under an act of Congress passed in 1866 regarding telegraph lines, it has no right under the laws of Virginia or the ordinances of the city of Richmond to use such streets. He will, therefore, at a later date issue a decree dismissing the bill of the complainant company and dissolving the injunction restraining the city from removing the poles and wires of the Bell Company from the streets of Richmond.

CANADIAN NOTES.

Ottawa, Ont., Jan. 6, 1900.

THE ELECTRIC STORAGE COMPANY, of Hamilton, Ont., is putting in 36 storage batteries in the Waterloo & Berlin Electric Street Railway system.

TO VOTE ON MUNICIPAL ELECTRIC LIGHT PLANT.—At a meeting of the city council for Woodstock, Ont., it was decided to submit the question of the establishment of a municipal electric light plant to a vote of the property holders of the city only.

CHANGES IN MANAGEMENT.—In connection with the changes in the management of the various enterprises controlled by the Cataract Power Company, of Hamilton, Ont., Mr. H. R. Leyden will become manager of the Hamilton Electric Light Company. Mr. C. K. Green has entered on his duties as traffic manager of the consolidated railways.

CHANGE OF CORPORATE NAME.—The Canadian Power Company, of Niagara Falls, Ont., has changed its name to the Dominion Power Company. This company has a franchise for the operation of its plants from the Dominion Government to take water from Chippewa Creek for power purposes. It is stated that General Fields, of Buffalo, N, Y., represents capital that has become interested in the project, and that work may be commenced soon.

MR. J. S. GAMBLE, solicitor of St. Catherines, Ont., has made application to the Dominion Parliament for incorporation of the Niagara & Southwestern Railway Company, with power to construct an electric railway from Niagara-on-the-Lake on through St. Catherines and Smithsville to Hagersville, with branches to Dunnville, Cayuga and Queenston. The Niagara Central Railway Company has been granted permission to use the streets of St. Catherines to extend its electric road through to the town of Beamsville, Ont.

General News.

THE TELEGRAPH AND TELEPHONE.

CAIRO, ILL.—The Cairo Telephone Company has been incorporated to operate telephone lines. Capital $8000. Incorporators, J. W. Klipinger, V. C. Klipinger, J. E. Roadrock, G. Holwerda, all of Cairo.

NEW HAVEN, IND.—The New Haven Home Telephone Company has been organized here. Capital $5000. Incorporators, H. F. Berberick, G. W. Miller, both of New Haven; G. F. Trier, of Fort Wayne.

MARSHALL, IND.—The Citizens' Telephone Company has been incorporated, with headquarters in this place. Capital $10,000. Incorporators, J. McMurtry, W. W. Cumminger, S. Hadley, C. Adams, H. Myers, all of Marshall.

DENVER, COL.—The Central Wyoming Telegraph Company has been incorporated. Capital stock $5000. Incorporators, A. A. Spaugh, M. R. Collins, H. N. Callender, H. B. Card, William McReynolds, George L. Willson, William Reynolds and H. C. Snyder.

MEADVILLE, PA.—The telephone situation here remains lively. The Bell Company's rates have been cut in two, dating from December 1, and the rate per month will be about 50 cents cheaper than the rate of the Meadville Telephone Company. The Bell Company will redouble its efforts and each company is daily adding to its list of subscribers. The subscribers to the new company make a contract for three years at $2 per month.

MT. VERNON, N. Y.—It is announced that the Mt. Vernon Telephone & Messenger Company has been acquired by the Whitney syndicate of New York, which recently purchased the local plant and franchises in New Rochelle, Yonkers, White Plains and Mamaroneck. The new company, it is said, will begin at once to construct its lines in Westchester County, in order that they may be connected with the parent plant to be built in New York.

FRANKFORT, KY.—Articles of incorporation of two telephone companies have been filed. The Kentucky & Indiana Telephone & Telegraph Company has a capital stock of $250,000. The chief incorporators are H. K. Cole, Owensboro, and James H. Carter, of Henderson. The Kentucky Telephone Company, of which articles of incorporation were also filed, is capitalized at $10,000. Its home is at Manchester, Ky. J. H. Sowder, of London, is the principal incorporator.

KNOXVILLE, TENN.—The Morristown Telephone Company, of Morristown, Tenn., has been placed in the hands of a receiver on the application of A. G. Torian, of Evansville, Ind. The company is an independent one, and has been organized about two years. E. S. Rhode, of Morristown, was appointed receiver. The company is said to have been insolvent for some time, and a fight for its possession is on between the People's Telephone Company, the independent company of this city, and the East Tennessee Telephone Company, which represents the Bell interests.

ELECTRIC LIGHT AND POWER.

CARROLLTON, GA.—The Mandeville cotton mills will install an electric lighting plant.

STARBUCK, MINN.—The contract for water works and electric light plant has been let to Fairbanks, Morse & Co.

ARKADELPHIA, ARK.—The city council has been petitioned for authority to improve the electric lighting system.

NEWPORT, ME.—Mr. W. S. Townsend is interested in an enterprise to form an electric light company in this place.

ABBEVILLE, LA.—An effort is being made in this place to secure a municipal electric lighting plant and water works.

RUSK, TEX.—Mr. T. C. Nuby will operate an electric light plant here. Further information can be obtained of Mr. J. W. Summers.

BASTROP, LA.—Mr. R. M. Adams has been awarded the contract at $9000 for the construction of an electric light plant and water works.

TUPELO, MISS.—Fifteen thousand dollar 6 per cent. 20-year bonds will be sold at an early date to cover cost of electric light plant recently purchased.

CLARKSDALE, MISS.—The city will issue $37,000 of bonds for the erection of an electric light plant and water works. Mr. Al Nachman is the city clerk.

GASTONIA, N. C.—The issue of $25,000 of bonds has been authorized by the council for the erection of an electric light plant. The mayor can give further information.

TALLAHASSEE, FLA.—A municipal electric light plant is to be established in the city and the city council has taken action thereon. The mayor can give further information.

HAZLEHURST, MISS.—The Hazlehurst Electric Light Company has been incorporated here with a capital stock of $5000. The incorporators are I. N. Ellis, G. I. Ragsdale and others.

WADESBORO, N. C.—At a recent election $25,000 was voted for an electric light plant and water works. Mr. Henry E. Knox, Jr., has been engaged to prepare plans and specifications for these improvements. The mayor of this place can give further information on the subject.

UTICA, N. Y.—The Utica Electric Light & Power Company has given a mortgage on its property to the Trust Company of America for $1,000,000. This is stated to be in furtherance of the project to develop and render available in Utica and surrounding towns the power at Trenton Falls.

MT. VERNON, ILL.—The city's contract with the Mt. Vernon Electric Light Company expires in a few weeks, and the administration is querying a number of neighboring cities regarding the cost of lighting their streets, prior to making a new contract. The present rate for arc lights on an all-night schedule is $90, which is regarded as excessive.

THE ELECTRIC RAILWAY.

NORRISTOWN, PA.—The Inland Traction Company has given a mortgage on its property for $200,000.

TRENTON, N. J.—The township committee of Hamilton has granted a franchise to the Trenton Street Railway Company to extend its line from Yardville to Allentown, N. J. The line from Trenton to Yardville is already in operation.

ST. PAUL, MINN.—There is a rumor that Mr. Appleyard, of Boston, president of the Chippewa Valley Electric Railway Company, has bought the plant and franchise of the Eau Claire (Wis.) Light & Power Company, which is bonded for $200,000.

NORRISTOWN, PA.—The Doylestown Railway Company has filed plans for extensions of its line. It is stated that the lines proposed are mere links in the chain of tracks which the Inland Traction Company is constructing in this and adjoining counties.

COFFEYVILLE, KAN.—A franchise to operate a street railway in Coffeyville has been asked for by Eastern capitalists, represented by C. L. Long, of this city. The franchise will undoubtedly be granted, and the promoters promise to begin work immediately thereafter.

THE OLD ADAMS ST. LOUIS-CHICAGO ELECTRIC RAILWAY.—Mr. Willard E. Winner, a Kansas City electric railway magnate, is in St. Louis for the purpose of reviving the old Adams plan to construct an electric railway from St. Louis to Chicago. He has been conferring with local moneyed men.

MARTIN'S FERRY, O.—The county commissioners have granted the franchise for an electric railroad to connect Bridgeport, Colerain and Mt. Pleasant

and ultimately Cadiz, to J. A. White and William McComas. The right of way is all secured and the survey made.

ALBANY, N. Y.—The New Paltz & Poughkeepsie Traction Company was incorporated, with a capital of $100,000, to operate a street surface railroad nine miles long from the Poughkeepsie ferry at Highland, Ulster County, on the New Paltz turnpike, to the Wallriver River at New Paltz.

HEMPSTEAD, L. I.—The board of trustees of this village, at a special meeting, unanimously granted a franchise to the Mineola, Hempstead & Freeport Traction Company. This settles the struggle for trolley rights through this section, which has been going on for the past three months.

ALBANY, N. Y.—The Kings County Elevated Railroad Company has just filed its report with the Railroad Commissioners for the two months ending September 30 last, as follows: Gross earnings, $106,074; operating expenses, $93,364; net earnings, $12,710; other income, $188; gross income, $12,898; fixed charges, $40,618; deficiency, $27,720.

CHARLESTON, W. VA.—The European Railway Electric Lighting Company, of New York, was incorporated here, to deal in apparatus for producing heat, light, power and gas. The authorized capital is $5,000,000. The stockholders are: James G. Gregg, Frederick C. Rowly, Frank M. Wells, William E. Jackson and Alfred P. W. Seaman, all of New York.

CLEVELAND, O.—Marcus A. Hanna, president of the Little Consolidated Street Railway Company, distributed $5000 among its employees on December 23. Mr. Hanna, it is stated, did this to show his appreciation of the employees for their position taken during the late trouble with the Big Consolidated, when they refused to go out.

MILWAUKEE, WIS.—The Milwaukee Electric Railway & Light Company on Jan. 3 began selling street car tickets at the rate of 25 for $1, good from 5:30 o'clock to 8 o'clock a. m. and 5 o'clock to 7 o'clock p. m. The action of the street railway is in accordance with the passage of the street railway ordinance through the Common Council, regardless of the injunction served on that body.

ASHEVILLE, N. C.—I. B. Wilford, of Bowling Green, Ky., backed by Chicago capitalists, will in a few weeks begin the construction of an electric railway from Asheville to Weaverville, a town eight miles north of here. Wilford has applied for a charter. The road will pass through the richest and most populous section of Buncombe County and will also traverse some of the principal resident streets of Asheville.

ST. LOUIS, MO.—The sum of $4,500,000 was turned over to the order of the Continental National Bank of St. Louis on December 27 to be paid to the holders of the deferred payment certificates of the Maryland Trust Company in payment of the 65 per cent. due on the stock of the Southern Electric and National Railway lines. The payment of $4,500,000 is the final step in the transfer of all the consolidating lines to the United Railways Company.

SPRINGFIELD, ILL.—The strike of the employees of the Springfield Consolidated Street Railway Company, which was settled by agreement, is on again. The men who had returned to work were called off again by order of the Federation of Labor on the ground that Manager Minary had violated the agreement by refusing to reinstate two of the men, and by placing new men on the cars ahead of the strikers.

ALBANY, N. Y.—The certificate of consolidation of the Albany Railway Company, the Troy City Railway Company and the Watervliet Turnpike & Railroad Company, to be known hereafter as the United Traction Company, has been filed with the Secretary of State. The capital stock of the new company amounts to $4,000,000, and the principal office will be in Albany. The directors are Robert C. Pruyn, Anthony N. Brady, John G. Myers, A. Bleecker Banks, John W. McNamara, James H. Manning, Simon W. Rosendale and William J. Walker, Albany; Edward Murphy, Jr., Charles Cleminshaw, William Kemp, Francis N. Mann, Jr., James O'Neill, William Shaw and C. V. Collins, Troy. The officers are: President, Robert C. Pruyn; vice-president, Charles Cleminshaw; treasurer, John W. McNamara.

PERSONAL.

MR. CHARLES DAY, class of 1899 of the University of Pennsylvania, has been appointed assistant to the superintendent of the Link Belt Engineering Company, Philadelphia.

MR. EDWARD P. BURCH, who resigned recently his position as electrical engineer for the Twin City Rapid Transit Company of Minneapolis and St. Paul, has opened an office as a consulting electrical engineer at 1210 Guaranty Building, Minneapolis, He will devote his energies to heavy electric railway work as a specialty.

ERIE TELEPHONE PERSONNEL.—We are enabled to present on this page a very interesting portrait group, showing the personnel and executive heads of the Erie Telephone & Telegraph Company, secured during a conference of all the departments of that progressive Bell telephone system. The Erie Telegraph & Telephone Company is the largest in America operating under the Bell patents, having 106,564 subscribers, and having made a gain during the year of 43,714, or 69 55/100 per cent. The Erie system operates in North and South Dakota, Minnesota, Wisconsin, Michigan, Arkansas, Texas and Cuyahoga County, in Ohio, which includes the city of Cleveland. The management predicts that the growth for the year 1900 will increase the grand total number connected at the close of the century to 150,000 subscribers.

OFFICIALS OF THE ERIE TELEPHONE SYSTEM.—Names Apply in Numerical Order from Left to Right, Beginning at Top.

1—WILLIAM J. BERRY, Gen'l Sup't Western Division, Michigan Co., Grand Rapids.

2—JAMES F. LAND, Gen'l Sup't Central Division, Michigan Co., Detroit.

3—ERLE K. BAKER, Gen'l Manager South Texas, Austin.

4—CHARLES L. BOYCE, Gen'l Sup't of Equipment, Detroit.

5—JOSEPH E. FARNSWORTH, Gen'l Mgr., North Texas, Dallas.

6—CHARLES E. NESTOR, Gen'l Contract Agent, Milwaukee.

7—FREDERICK A. FORBES, Local Director Michigan Co., Detroit.

8—GEORGE D. SHERMAN, Gen'l Sup't Northern Division, Michigan Co., Marquette.

9—PETER G. REYNOLDS, Gen'l Sup't of Construction, Milwaukee.

10—CHARLES A. GATES, Gen'l Sup't Eastern Division. Michigan Co., Saginaw.

11—JAMES P. McKINSTRY, Vice-President, Cleveland.

12—CHARLES J. GLIDDEN President, Lowell.

13—HEMAN J. PETTENGILL, Vice-President, Lowell.

14—DARIUS F. MORGAN, General Counsel, Minneapolis.

15—CHARLES E. WILDE, Gen'l Sup't Southern Division, Michigan Co., Kalamazoo.

16—CHARLES P. WAINMAN, Gen'l Mgr. Northwestern Co., Minneapolis.

17—ELISHA W. BENNETT, Sup't of Supplies, Chicago.

18—PETER YENSEN, Gen'l Mgr. Cleveland Co., Cleveland.

19—THOMAS L. POWELL, Gen'l Mgr. Arkansas, Little Rock.

20—EDWARD D. TROWBRIDGE, Gen'l Sup't Long Distance Service, Detroit.

21—EDWIN B. COTTRILL, Gen'l Sup't Wisconsin Co., Milwaukee.

PRESIDENT J. M. CRAFTS, of the Massachusetts Institute of Technology, has tendered his resignation of that office, to take effect at the end of the present school year. In his letter to the corporation Mr. Crafts gives as his reason for resigning the desire to have more freedom for the pursuit of experimental science. Mr. Crafts was elected president of the Institute of Technology in 1897.

THE AUTOMOBILE.

THE AUTOMOBILE STORAGE REPAIR COMPANY, of New York, has been incorporated with a capital stock of $50,000. It will deal in automobiles and motor vehicles of all kinds.

FORT WORTH, TEX.—Several of Victoria's stockmen have jointly purchased an automobile, which is now en route to that place. If it meets their expectations more will be ordered built, especially for use on the ranches in this section.

THE AMERICAN ELECTRIC VEHICLE COMPANY, capital, $5,000,000, has been incorporated to manufacture vehicles of every kind, propelled by any power whatsoever, and to produce and supply such power. The incorporators are Myles Tierney, George B. Hurst, New York; George T. Lister, Jersey City, and Henry Young, Jr., Newark.

THE CLEVELAND MOTOR VEHICLE ENTHUSIASTS who are advocates of the electric type of machine are greatly elated at the outcome of the automobile parade held on New Year's day. At the time of the start every electric machine was in position ready for the word, but not another vehicle had put in an appearance. The other machines fell in, one or two at a time, along the route. The electrics covered the route without any mishap, while on the other hand the gasoline and steam wagons were constantly in trouble. One gasoline wagon burned out, another was stalled and had to be carted home; one of the steam wagons became unmanageable and collided with a telegraph post with disastrous results, while still another ran out of water and had to lay up for a new supply. There were 11 electrics, 12 gasoline and three steam vehicles in line.

EDUCATIONAL.

THE UNIVERSITY OF PENNSYLVANIA has just received another gift of $250,000 from the Houston estate. Fifty thousand dollars of this is to be used for the addition to the university dormitories and the balance as the trustees may decide. Mr. J. Vaughan Merrick has presented to the university funds covering the purchase of air pump and jet condenser, indicators, water power plant, milling machinery, alternating cnrrent voltmeters and ammeters and other small apparatus for mechanical and electrical engineering laboratory work.

NEW COMPANIES.

THE AMERICAN ELECTRIC APPLIANCE COMPANY, of Philadelphia, has been formed under the laws of Delaware to manufacture electrical devices. Capital $100,000.

THE ELECTRIC FIRE ENGINE COMPANY OF AMERICA has been incorporated at Des Moines, Ia., for the purpose of manufacturing and selling electric fire engines. Capital $50,000. Incorporators, T. Johns, W. B. Shaffer, W. Bishop, J. Carmody, C. A. Blomgren, all of Des Moines.

THE MARSHALL-SANDERS COMPANY has been organized at Portland, Me., for the purpose of manufacturing and dealing in electrical apparatus and appliances, with $50,000 capital stock. The officers are: President, C. M. Drummond, Portland; treasurer, Frederick K. Leighton, Portland.

ALBANY, N. Y.—Articles of incorporation of the Niagara Falls Gas & Electric Light Company, of Niagara Falls, with a capital stock of $100,000, was filed with the Secretary of State. The directors are: Harry Highland, Amasa A. Oatman, Elizabeth Read, Niagara Falls; Walter D. Ingham, Buffalo, and David W. McNair, New York City.

THE WATTS ENGINEERING COMPANY filed articles of incorporation in Missouri Jan. 3. It has $100,000 capital stock, all paid up. The shares are held by Sylvester Watts, G. J. Brooks and John Watts. Its purpose is to construct and operate, buy and sell waterworks, gas works and electric plants and other industries pertaining to their line of business.

Trade and Industrial Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, write that their factory making the Gutmann wattmeters have reported their ability to turn out these meters so as to fill all orders promptly.

THE MAXWELL M. MAYER ELECTRIC COMPANY, 2369 Second Avenue, New York, has issued a neat card containing an illustration of a Mayer machine. This company manufactures dynamos and motors for power, light and plating work.

THE GRANT MACHINE TOOL WORKS, Cleveland, Ohio, has issued a neat pamphlet describing and illustrating the product of this concern. This company manufactures hand lathes, taper turning lathes, turret chucking and turning machines, hopping machines, radial drills, milling machines, friction pulleys, etc.

THE LAWRENCE MACHINE COMPANY are installing for the Edison Electric Illuminating Company, Brooklyn, an 8-inch composition double suction water pump. The pumps of the Lawrence Company are meeting with great success wherever installed and Mr. H. E. Maxfield, their New York representative, reports an exceedingly good business since opening of New York office on Dec. 1.

ELECTRIC STAGE LIGHTING.—The Universal Electric Stage Lighting Company, 842 Broadway, New York, has issued a catalogue of electric stage lighting apparatus and effects, electric signals and illuminations The various devices for accomplishing these results are illustrated. They include border lights, bunch lights, dimmers, hand-feed arc lamps, rheostats, switchboards, etc. A full line of supplies is also listed. The company makes a specialty of the manufacture of electric advertisements and signs and has constructed some of the largest electric signs in New York.

ELECTRICAL NOVELTIES.—Messrs. E. B. Latham & Co., 136 Liberty street, New York, are offering a full line of electrical novelties at once useful, practical, economical and ornamental. They consist of the "Ever Ready" flash light, electric walking canes, interior searchlights, gas lighters, night lights, dental lamps, candles, etc., etc. A pamphlet is issued by the firm illustrating and describing these various devices. This firm also handles, among other electrical supplies, a full line of porcelain tubes, insulators, cleats, ceiling rosettes, switches, etc., of all sizes. A general catalogue of electrical supplies can be had on application.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, Mo., are making very energetic efforts to bring before the public the coming season a telephone system revised, improved and modern in every detail, embodying all the essential features of the best known equipment, and employing many new and valuable points. They succeeded last season in pushing their telephone apparatus to the front in such a manner as to be recognized as one of the leaders of the independent telephone movement. They claim that the prospects look even brighter and are trying to prepare with their new apparatus for the demand. They have already started the year with some orders of large size. They have a number of circulars covering their switchboard and telephone apparatus, which will be mailed on application.

GENERAL ELECTRIC TRADE LITERATURE.—The General Electric Company has recently issued a couple of pamphlets that are in keeping with the high artistic standard adopted for its trade literature. In one of them is reprinted an article by Mr. H. W. Hillman entitled "The Arc Lamp Department of the Central Station Business—Interior Lighting." Several interior views are given of store interiors, showing the excellent illumination obtained by arc lamps. The other pamphlet is devoted to electric hoists, of which many types and sizes are illustrated. Brief descriptions of these machines are given, together with tabulated data. The cover of this pamphlet is a very artistic production. Other literature just brought out consists of Bulletins 4210, 4211 and 4212, devoted respectively to rheostats for generators, motors and projectors; wiring devices for 220-volt circuits and Brush arc generators. Two folders from the supply department of the company give price lists of General Electric porcelain specialties and brushes for arc generators.

CALENDARS FOR 1900.—Many enterprising manufacturers and dealers in electrical and kindred supplies usually remember their friends in the trade at the beginning of each new year by distributing calendars. These calendars afford an excellent opportunity for the indulgence of the artistic sides of their natures and some excellent artistic results are developed. The calendars of each year seem to surpass those of preceding years in artistic merit, and represent a great variety of ideas and tastes. Among this year's productions to enable us to keep track of passing time may be mentioned those from the folllowing named concerns: The Commercial Cable Company, New York; the Okonite Company, New York; F. M. Watkins, gas and gasoline engines, Cincinnati, Ohio; the Standard Tool Company, Cleveland, Ohio; the W. K Garton Company, Chicago, Ill.; H. B. Russell & Co., patents, Washington, D. C.; the Direct United States Cable Company, the American Electric Works, the Rollins Engine Company, of Nashua, N. H.; the Phillips Insulated Wire Company, Pawtucket, R. I., and the Western Electric Company.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JAN. 2, 1900.

[In Charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

640,196. ELECTRIC METER DEVICE; C. D. Haskins, Newton, Mass. App. filed Oct. 26, 1898. (See Current News and Notes.)

640,204. TROLLEY; C. A. Jackson, Lewiston, Me. App. filed Feb. 16, 1899. A spring bears against a flattened surface on a swinging post which carries the trolley wheel, the tendency of the spring being to keep the wheel in the same plane as the wire.

640,258. ELECTRIC HEATER; F. Bain, Chicago, Ill. App. filed Sept. 30, 1898. A shell containing an electric heater for a curling iron is inserted between an incandescent lamp and the lamp socket.

640,273. ACOUSTIC ALARM SYSTEM; E. Coleman, Chicago, Ill. App. filed Sept. 3, 1897. This invention is for the protection of safes and vaults, such enclosures being provided with sound chambers in which microphones are located. The hammering, boring or other noises made by a person endeavoring to break through the walls, is transmitted by the microphone to a suitable signaling apparatus.

640,278. MULTIPLE SIGNAL TRANSMITTER; L. Dawson, Needham Mass. App. filed May 5, 1899. The box includes a circuit operating device, a box number wheel, a "special" signal wheel and arms projecting

from the circuit operating device adapted to co-operate with both of said wheels, one of the arms being adjustable relative to the other, whereby the length of the intervals of time the circuit is opened by the circuit operating device may be varied.

640,314. ELECTRIC TRANSFORMER; J. W. Packard and A. Wiswell, Warren, O. App. filed June 23, 1898. A method of winding and insulating, consisting in placing a layer of insulating material over a layer of wire prior to putting on the last turns of wire, the insulating material projecting beyond the core, then finishing the winding of the layer and beginning the succeeding layer, then folding in the projecting end of the sheet upon the body thereof to surround the end turns of wire, then confining the projecting end by succeeding turns of wire of the second layer and so on.

640,363. TERMINAL FOR ELECTRIC CABLES; W. L. Candee, New York, N. Y. App. filed Feb. 16, 1899. Renewed Nov. 10, 1899. (See Current News and Notes.)

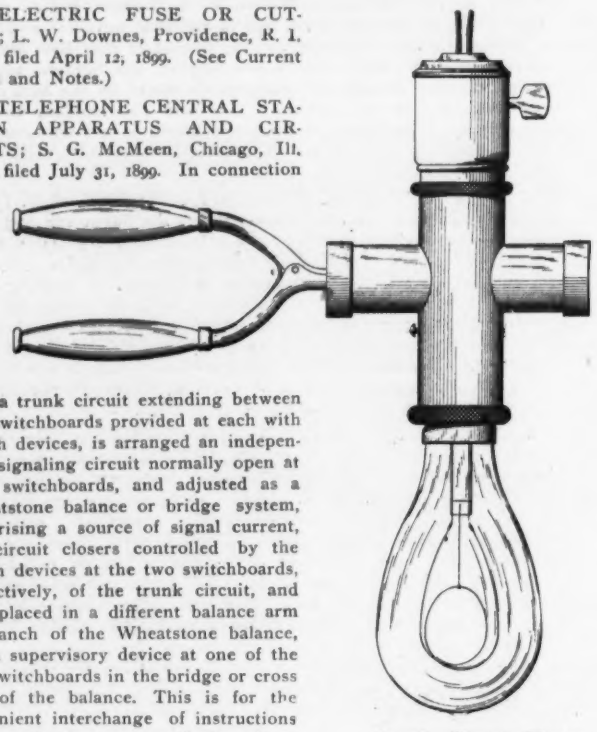
640,364. TERMINAL FOR ELECTRIC CABLES; W. L. Candee, New York, N. Y. App. filed Feb. 17, 1899. Renewed Nov. 10, 1899. (See Current News and Notes.)

640,365. TERMINAL FOR ELECTRIC CABLES; W. L. Candee, New York, N. Y. App. filed Feb. 17, 1899. Renewed Nov. 10, 1899. (See Current News and Notes.)

640,366. ELECTRIC INCANDESCENT LAMP; Francis M. F. Cazin, of Hoboken, N. J. App. filed March 21, 1899. Relates to improvements in the Cazin electrolytic lamp. The filament or luminous structure consists (1) of a central conducting core, part of which is longitudinally intercepted; (2) an insulating covering or sheath for the core, and outer parts consisting of concentrically laid sections of rare-metal oxides, which bridge over interceptions in the core part.

640,371. ELECTRIC FUSE OR CUT-OUT; L. W. Downes, Providence, R. I. App. filed April 12, 1899. (See Current News and Notes.)

640,404. TELEPHONE CENTRAL STATION APPARATUS AND CIRCUITS; S. G. McMeen, Chicago, Ill. App. filed July 31, 1899. In connection with a trunk circuit extending between two switchboards provided at each with switch devices, is arranged an independent signaling circuit normally open at both switchboards, and adjusted as a Wheatstone balance or bridge system, comprising a source of signal current, two circuit closers controlled by the switch devices at the two switchboards, respectively, of the trunk circuit, and each placed in a different balance arm or branch of the Wheatstone balance, and a supervisory device at one of the said switchboards in the bridge or cross wire of the balance. This is for the convenient interchange of instructions between the operators at the boards.



640,258.—Electric Heater.

640,419. PROCESS OF COATING OXIDIZABLE METAL WIRE WITH GAS TIGHT COATING; F. O. Schott, Jena, Germany. App. filed June 28, 1899. (See Current News and Notes.)

640,465. INCANDESCENT LAMP; E. W. Gillmer, Warren, O. App. filed March 4, 1898. The anchor wire for the filament is secured to the lamp stem by twisting it in a peculiar manner around the outside thereof.

640,466. RATE INDICATOR FOR ELECTRIC CURRENTS; Jesse Harris, Albany, N. Y. App. filed Aug. 1, 1899. A solenoid core moves an arm or beam; a weight on the arm or beam is arranged to move along with the same, and means are supplied for indicating its movement so as to make one indication for each pre-determined maximum current reaching it in successsion.

640,478. LIGHTNING ARRESTER; J. M. Metcalf, Glenhaven, Wis. App. filed Aug. 30, 1899. Details of construction.

640,479. CONNECTOR FOR BATTERY ELECTRODES, FUSES, ETC.; W. Mills, Elizabeth, N. J. App. filed March 16, 1899. The connector consists of a coil spring between the convolutions of which the line wire may be inserted and clamped; one end of the spring is extended to enter a slot in the electrode with which it engages by frictional contact.

640,482. JUNCTION BOX; T. J. Murphy, New York. App. filed May 17, 1899. The junction box is collapsible for easy transportation and is so put together that it may be readily constructed in different forms and dimensions by workmen of ordinary skill.

640,515. ART OF DISTRIBUTING ELECTRICAL ENERGY BY ALTERNATING CURRENTS; M. I. Pupin, New York, N. Y. App. filed May 21, 1895. Renewed Dec. 4, 1899. (Extended notice next week.)

640,516. ELECTRICAL TRANSMISSION BY RESONANCE CIRCUITS; M. I. Pupin, New York, N. Y. App. filed May 28, 1895. Renewed Oct. 14, 1896. (Extended notice next week.)

640,532. TERMINAL FOR CABLES; J. N. Byers, Urbana, Ohio. App. filed Oct. 4, 1899. (See Current News and Notes.)

640,533. CABLE TERMINAL; W. Callahan, Toledo, Ohio. App. filed Dec. 6, 1898. (See Current News and Notes.)

640,560. TROLLEY; A. W. Hauver, Fitchburg, Mass. App. filed May 31, 1899. A fork and swinging frame arranged to automatically set the wheel back on to the wire when it accidentally leaves it.

640,565. SYSTEM OF ELECTRICAL DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed July 27, 1899. The invention consists of a special arrangement of a regulating system in connection with a three-wire circuit whereby a single booster serves for both sides of the circuit. This is in connection with systems wherein storage batteries are used as load and voltage equalizers with a booster which serves to compensate for the excess of charging voltage over discharge voltage.

640,575. MOLDING OR TROUGH FOR ELECTRIC WIRES; H. Lee, Chicago, Ill. App. filed Oct. 7, 1899. This invention is designed to temporarily hold wires in the grooves of a molding while wires are being strung. For this purpose lateral holes are made in the molding in which cross pins may be inserted at intervals to lay over the wires and temporarily hold them.

640,603. FIELD MAGNET; M. S. Towson, Cleveland, O. App. filed Sept. 5, 1899. The magnet cores are built up of two separate sets of laminations secured in a frame. The frame is attached to the yoke by bolts which enter between the two sets of laminations and engage with the frame.

640,618. TELEPHONE EXCHANGE SYSTEM; T. F. Ahern, Detroit, Mich. App. filed June 26, 1899. This system comprehends a metallic return between two connected subscribers when conversing; also, that the calling subscriber calls and rings off by a current passing through one of these wires only, and returning to complete the circuit through the ground, and that the called subscriber is called over the opposite line from that which is used by him in calling or ringing off, the return of this circuit also being through the ground.

640,688. SPEED GOVERNOR ATTACHMENT FOR ELECTRICAL APPARATUS; J. H. McGurty, Jersey City, N. J. App. filed April 7, 1899. A gear train and governor are arranged in connection with the controller shaft to regulate the speed with which the controller shaft can be turned.

640,727. ELEMENT FOR ELECTRIC BATTERIES; F. R. Wiley, Malden, Mass. App. filed May 13, 1898. (See Current News and Notes.)

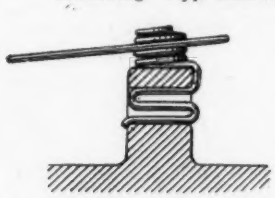
640,729. ELECTRIC LAMP; Willis A. Fenner, Providence, R. I. App. filed May 15, 1899. Means are described for mounting a lamp in a reflector and of attaching the reflector by means of ball and socket connection so that it may be moved in any direction.

GERMAN PATENTS ISSUED DEC. 20, 1899.

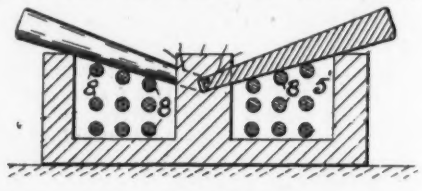
[In Charge of Dr. Ralph Julian Sachers, 120 Liberty Street, New York.]

105,337. AMOR-CLAD ELECTRIC CABLE; Edwin Truman Greenfield, New York. App. filed Nov. 16, 1897. A metal strip is wound spirally around the cable in such a way as to have a small space between the edges of two adjoining turns. A second metal strip provided with ribs or noses, engages in the said spaces and is separated from the first metal strip by means of an insulating band.

105,543. TIME-CONTROLLED CURRENT SWITCH; Hans Henning, Charlottenburg. App. filed April 19, 1898. This switch is built on the principle of a sand-glass, rotatable on a horizontal axle. The bottom of each half of the sand-glass is flexible. A sliding frame surrounds the sand-glass, the top of which forms the contact piece for the electric terminals. The bottom piece of this frame has a notch in which engages an arm of a two-armed lever; the other arm carries a counterweight, which presses the first arm and the frame resting on the same in an upwardly direction and thereby closes the circuit. As soon as the material in the upper compartment has filled the lower one, the weight will overcome the counterweight, the lever arm will disengage from the lower end of the frame and the frame with the sand-glass will revolve around its axle.



640,470.—Connector for Battery Electrodes, Fuses, Etc.



640,575.—Molding or Trough for Electric Wires.

105,602. SWITCHBOARD; Jean Jacques Heilmann, Paris. App. filed May 4, 1898. This invention is a modification of a switchboard as shown in the United States patent No. 490,178. The resistances placed in the different branch circuits are of sufficient self-induction to accomplish a sparkless breaking of the circuit.

105,846. OSCILLATING WATTMETER; Frank Holden, London, and Alexander S. Garfield, Paris. App. filed Nov. 5, 1898. The circuit of a shunt-coil is closed in certain periods by means of a clock work. This shunt-coil may go through a limited oscillation within a main coil and is forced against its end position by means of a number of adjustable and current-carrying torsion-coils. The motion of the coil takes place with a speed proportioned to the watts passing through the instrument at the same moment. This motion is transmitted to a disk by means of a one-sided acting clutch, which disk rotates in a suitable way the clock-dial.

105,882. INCANDESCENT LAMP; Friedrick Egger, Venloo. App. filed Feb. 27, 1897. The socket of the globe is removable and is connected to the globe by means of pins passing through holes in the socket, and through suitable grooves on the globe.

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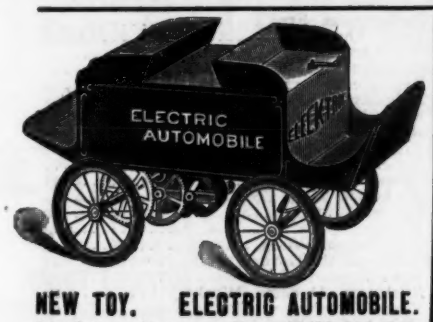
Illinois Elect. Co., 239 Madison St., CHICAGO, ILL.
Standard Elec. Co., 201 W. Pearl St., cor. Elm, CINCINNATI, O.
Elec. Supply & Mfg. Co., 62 Public Square, CLEVELAND, O.



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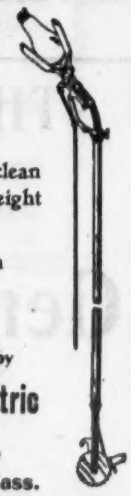

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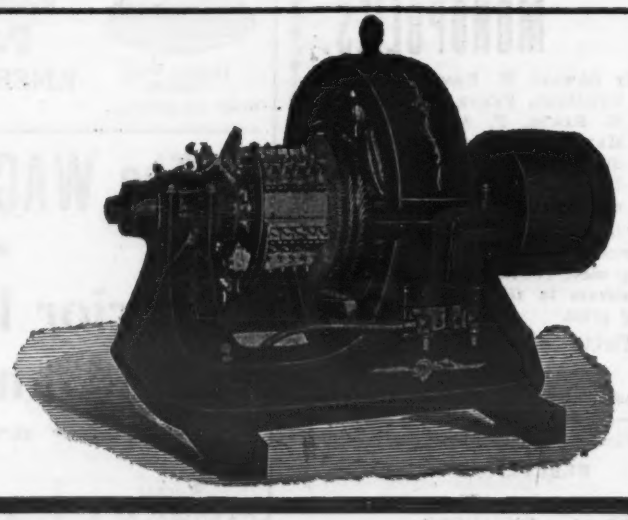

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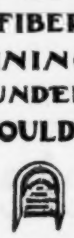

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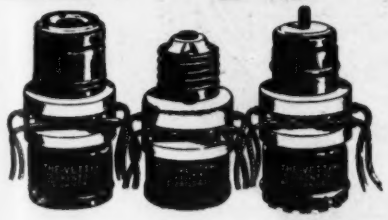

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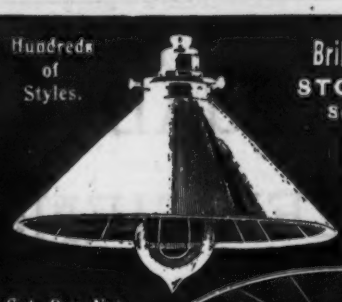
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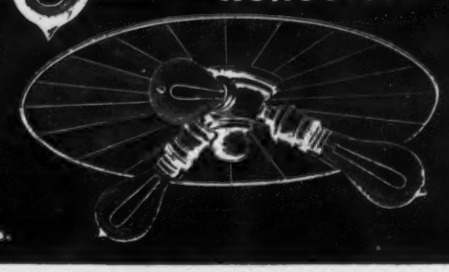
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